Web of scientists

Antecedents and outcomes of the social embeddedness of researchers.

A dissertation submitted in partial satisfaction of the requirements

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"Research performance, unlike many other kinds of work, cannot be enforced. Rather, it must come as a product of the enthusiasm that an individual feels toward his work."

(Glaser, 1965, p. 83)

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INTRODUCTION

The classic image of researchers has been the ingenious mind, working alone. For example, Isaac Newton, Albert Einstein and Charles Darwin were all researchers that turned into iconic public figures due to their individual exceptional contributions to science (Barabási, 2005). The vision that these genius researchers worked alone is created because their publications were single-authored. However, it is rather exceptional that researchers worked in isolation. Already in the 17th century, academic researchers were embedded into colleges. Studies on the 'invisible colleges' show that communication among academic researchers from different colleges was never mute. Through letters, printed papers and commentaries, an elite group of researchers was kept up-to-date with the latest developments within their research field, even in times when personal, informal communication and meeting opportunities were not that extensively developed and accessible as now (Price & Beaver, 1966). Since the era of the invisible colleges, the possibilities for personal contact (meeting opportunities at conferences, communication through telephone and internet, international travel) among researchers has grown. Because of this development, the 20th century was a turning point in that collaboration between scientists intensified (Barabási, 2005; Galison & Hevly, 1992). Entering the 21th century, the majority of academic research is executed by multiple researchers jointly and large collaboration projects are funded to execute cutting edge research (Barabási, 2005; Jones, Wuchty, & Uzzi, 2008; Wuchty, Jones, & Uzzi, 2007). Examples of these large collaboration projects are the ATLAS and CMS projects executed with the Large Hadron Collider at CERN, which in 2012 independently observed particles consistent with the Higgs boson. Roughly 3000 physicists, from 177 universities and laboratories within 38 countries, are involved with the ATLAS project, making it one of the largest collaborative efforts ever attempted in the physical sciences (Atlas Experiment, s.d.). Around 2500 physicists, coming from 182 institutes and 42 countries, work together at the CMS project (Taylor, 2014). Even though more examples of large scale research projects exist, they are not yet the dominant way to organize research. Most often, academic research activities are structured within teams, which typically consist of (doctoral)students, technicians, and postdoctoral fellows attached to a single professor (Cohen, Kruse, & Anbar, 1982; Etzkowitz & Kemelgor, 1998; Hagstrom, 1964; Hoegl, Parboteeah, & Munson, 2003). Characteristic for academic research teams is that they seek (formal and informal) collaborations with other research teams, however often in a much smaller scale than the large scale research projects (Bush & Hattery, 1956; Etzkowitz & Kemelgor, 1998; Hagstrom, 1964; Katz & Martin, 1997).

A similar trend towards intensified collaboration is visible within private organizations occupied with research activities. Traditionally, industrial research teams were rather closed. Before the

1960s, research teams were often islands within the company, working on scientific breakthroughs while having little or no interaction with the rest of the company. After this period, research became part of the organization's strategy and research and development (R&D) management strategies started focusing on embedding the research teams within the organization. Simultaneously, organizations started acquiring external knowledge and innovations by setting up formalized strategic alliances (e.g. outsourcing, licensing, joint ventures, consortia). From then on, researchers no longer collaborated only with colleagues within the team, but also with other individuals from the same organization and even with organizations they had strategic alliances with. Another shift in R&D management strategy around the mid-1990s made that R&D is conceptualized as a network activity, focusing on collaboration with competitors, suppliers, distributors, etc. In addition to the strategic alliances - which continue to exist - collaboration is now also possible in a less formalized way, and with a broader group of contacts (Nobelius, 2004; Trott & Hartmann, 2009).

Both governmental policies and managerial strategies steered the trends towards intensification of collaboration among researchers. In particular, as scientific research is increasingly the source of new lines of economic development, the investments in research by public and private actors is stimulated and kept at high levels (Etzkowitz & Leydesdorff, 2000). In the Flemish context we see that the research staff employed at universities and private organizations grows year after year (Debackere & Veugelers, 2013). The community of researchers keeps growing at a national and international scale (Barabási, 2005; Wuchty et al., 2007). With the eye on valorizing more of the knowledge and innovations brought forward by these investments, policymakers stimulate collaboration and knowledge sharing among academic and industrial researchers already since the mid-1970s (Van Dierdonck, Debackere, & Engelen, 1990). In addition, there is a general managerial push towards more collaboration, since it improves organizational effectiveness, extra-role behavior, and organizational citizenship behavior. In practice, this resulted in the introduction of team-structures within organizations, which enhance collaboration (Jones & George, 1998). Within private organizations, teams are nowadays the organizational unit in which research activities are performed. New ideas for almost all organizational innovation are proposed and pursued towards implementation by research teams (Hulsheger, Anderson, & Salgado, 2009).

The intensified collaboration among researchers makes that academic and industrial researchers are nowadays embedded within social networks at the research team (seen as unit within an organization), organization and research field level. Even though researchers set up

collaborations, they are technical professionals with highly specialized knowledge background who prefer to work with a certain level of autonomy (Bailyn, 1985; Bush & Hattery, 1956; Levi & Slem, 1995). This has implications on formal structures such as research teams in which they are embedded. Unlike production and operation work teams, team members in research teams are granted, to some extent, the freedom to set the research agenda and/or to execute the research agenda (Bailyn, 1985; Bush & Hattery, 1956; Levi & Slem, 1995). Hence, research teams should not be seen as standard work teams, is which the work is strictly hierarchically managed.

Collaboration has been found to be specifically valuable for research tasks due to the nature of these tasks and related to that, due to the way research is actually performed. Innovative research tasks have a non-repetitive nature and are often complex, requiring a combination of multiple researchers their skills and knowledge (Chen, Chang, & Hung, 2008; Hagstrom, 1964; Henttonen, Janhonen, Johanson, & Puumalainen, 2010; Katz & Martin, 1997; Lee, Wong, & Chong, 2005). In other words, to successfully complete innovative research tasks, resources that are accessible through social relations (i.e. social capital) are a necessity. In the last decades, scholars have studied a range of facilitators and inhibitors of innovation within teams (team diversity, task and goal interdependence of team members, internal communication, external communication, conflict, etc. (for a review see Hulsheger et al., 2009) which in essence all relate to getting the right combination of resources within a team and making that these resources are shared among team members. Hence, for team level innovative performance, the intra-team network – that is the network of diverse social relations existing among the team members - is found to be a relevant factor (Henttonen, 2010). In particular, strongly interconnected intra-team networks were found to bring forward benefits to teams occupied with innovative research tasks (Henttonen, 2010; Reagans & Zuckerman, 2001). These findings lead to the pertinent question of how these beneficial intra-team networks can be achieved. Only through knowledge about factors that influence the structure of intra-team social relations, the benefits for teams brought forward from social relations can be enhanced. Hence, the first objective of this dissertation is to gain more insight into which factors influence the relational structure of research teams. Intra-team relations are argued in this dissertation to be the result of both the individuals' preferences to interact and contextual factors that structure the social behavior of individuals. The existing research on antecedents of social relations and network structures is fragmented and diverse (Borgatti & Foster, 2003; Mehra, Kilduff, & Brass, 2001) and rarely addresses the interpersonal relations among researchers. Therefore, antecedents of intra-team relations that are examined in this dissertation were chosen because they are relevant for the specific context of researchers and research teams.

Furthermore, since research tasks require collaboration, researchers wanting to perform well need to set up interpersonal contacts with others. Although the personal work-related networks of researchers often cross the borders of their team into the wider organization and research community, researchers have been found to spend half of their time collaborating with colleagues from within their own research team (Lee & Bozeman, 2005). Teams can thus be seen as the primary social structure in which researchers collaborate. However, it is remains up-until-now still unclear whether team members or rather other contacts bring social capital benefits for the researchers' innovative performance. Since relationships demand an investment of time and resources, one cannot connect to an unlimited number of contacts. Due to these restriction, it is relevant to know which contacts are valuable. Hence, the second objective of this dissertation is to examine the importance of team relations for researchers' innovative performance, taking into consideration that also contacts with other organizational researchers or even external researchers are present within the researchers' networks.

The next chapter elaborates on the theoretical foundation of this dissertation, and places the research objectives within the existing research. The background information on the gathered data and the used methodology is found in Chapter 2. The subsequent chapters present four empirical studies. The first three empirical studies (Chapters 3 to 5) relate to the first research objective and focus each on a different individual or contextual antecedent of intra-team relations. A final empirical study (Chapter 6) focuses on the outcomes of the personal networks of researchers for individual level innovative performance. The final chapter, Chapter 7, summarizes the findings of the empirical studies and discusses the findings in relation to the main research questions of this dissertation.

1. THEORETICAL FRAMEWORK

Research work is a social activity in that researchers have to ask advice, share knowledge and cooperate in order to cope with the complex tasks at hand (Bozeman & Corley, 2004; Chen et al., 2008; Hagstrom, 1964; Henttonen et al., 2010; Katz & Martin, 1997; Lee et al., 2005). Therefore, researchers are encouraged by managers and policymakers to build networks of interpersonal contacts. As a result, researchers find themselves embedded within team (as organizational unit), organizational and research field level networks. Focusing on the interpersonal relations of researchers, this dissertation deals with two particular research questions: 1) Which factors influence the presence or absence of intra-team relations?, and 2) How important are team contacts and external contacts for individual researchers' innovative performance?. The aim of this chapter is to theoretically frame these research questions by critically examining prior research on the social embeddedness of researchers and proposing a theoretical perspective. This will result in a conceptual framework, which reflects the theoretical perspective and presents how the research questions are addressed.

1.1 Prior research on the embeddedness of researchers

Studies on the social embeddedness of researchers are found within two distinct streams of studies. The first stream of research consists out of studies on the morphology of academic networks, which gave rich descriptions of the networks among researchers. Second, the small group literature gave insights into the benefits of the embeddedness of individuals within team structures for individual and team innovative performance. In this section, both literature streams are reviewed, thereby pointing out strong aspects as well as shortcomings.

1.2.1 Studies on the morphology of academic networks

Especially during the 1960s and 1970s, sociologists focused on the morphology of the networks, at the department, university or discipline level, among academic researchers. These studies examined for example the presence of invisible college structures, that is the presence of a small international in-group of researchers which communicate intensively within their discipline and a larger number of researchers who participates less intensively (Crane, 1969; Griffith & Mullins, 1972; Price & Beaver, 1966). Other studies focused on the relation between the formal and informal structures. For example, Blau (1973) found that the formal university structure (that is the bureaucratic structure) influenced the patterns of communication among university faculty. Academic departments were thereby seen as the primary sites of integrative social networks within universities, a point that was later opposed by Friedkin (1978), who found

multidisciplinary networks within universities. Also Mullins (1968) found that the networks of individual researchers cross the borders of formal social structures such as the department, discipline or research organization. Furthermore, scholars researched antecedents of technical communication relations and found relations were homophilic based on the field of specialization, rather than the status of the researchers (Blau, 1974; Mullins, 1968). The examined networks in this stream of research are made up of informal technical communication relations and are examined by quantitative analyses.

Even though these examples do not form an exhaustive literature review, all in all it can be concluded that the strand of sociological research studying the morphology of academic networks was relatively small and did not expand much in later years. However, simultaneously and in many respects similar strand, scientometrics, became known to a wider group of scholars due to the works of Price (1961; 1963). Scientometrics also quantitatively studies the communication networks among researchers, but in contrast to the former studies uses secondary data. Initially, the networks were built on citation relations: researchers are connected with each other in a network when a researcher refers to another researcher in his/her publications (Price, 1965). Scientometric studies deal with the influence of researchers within a field and the development of areas of knowledge over time (Furner, 2003). This strand of research developed further in that not only citation networks are now studied, but also co-author and co-patent networks. Through co-author and co-patent networks, the collaboration structure among researchers is visible. Co-author networks have been found to be structured as "small worlds", i.e. all researchers are located only in a short social distance from each other and through a small number of indirect relations, all researchers are connected with eachother (Newman, 2001).

Although both sociological and scientometric studies bring forward detailed insights on the networks of researchers, the networks are only examined within departments, universities or disciplines. The fact that a substantial portion of contemporary research is carried out by teams is ignored by these strands of research (notable exception: Cohen et al., 1982). Furthermore, the major shortcoming of scientometric research is that due to the usage of secondary data, a bias is created in the sample as only a small elite group of researchers publishes papers (and patents) (Katz & Martin, 1997). Finally, both the sociological and scientometric studies are mostly concerned with describing the network structure, as an 'invisible college' or a 'small world'. Although within scientometric research, some attention goes to the outcomes (such as patents or publications) of the structural position of individual researchers, questions related to why these

social relationships among researchers come into existence or whether these relationships bring forward specific outcomes are insufficiently addressed.

1.2.2 Small group research

The research on small groups or teams (the terms are used interchangeably in this dissertation) is extensive, with thousands of studies from several disciplines and subdisciplines published since the 1950s (Poole, Hollingshead, McGrath, Moreland, & Rohrbaugh, 2004). As an overview of contemporary perspectives is available elsewhere (Poole et al., 2004), the focus here lies on two strands of literature within small group research which deal with the importance of the embeddedness of individuals within team structures for individual and team innovative performance.

First, a group of studies examines intra-team relations from a social network perspective. This perspective on small groups was popular in the 1950s and 1960s and has revived in the 1990s and 2000s. In the first research period, it was mainly the Group Networks Laboratory at MIT, under direction of Bavelas and Leavitt, that performed group level social network research. The studies were socio-psychological experiments and examined the effect of the communication pattern among group members on the group functioning and performance (Katz, Lazer, Arrow, & Contractor, 2004). By 1990s, social network analysis as a method had progressed, but was up-until then mainly applied on individual and organizational level networks. Again, a stream of research developed on the social networks of small groups, which continues in part with the research topic of the older studies - group functioning and performance (Cummings & Cross, 2003; Kratzer, Leenders, & Van Engelen, 2004, 2005, 2010; Reagans, Zuckerman, & McEvily, 2004; Reagans & Zuckerman, 2001; Sparrowe, Liden, Wayne, & Kraimer, 2001). A distinction with the older research is that these newer studies no longer have an experimental approach, but examine field data on teams. Also the types of relations studied are broadened from communication relations to instrumental (e.g. advice giving), expressive (e.g. friendship) and even negative (e.g. dislike) relations (Henttonen, 2010). Both research generations have been investigating a variety of work groups: academic teams, manufacturing teams, R&D teams, project teams, etc. (Henttonen, 2010).

The merit of this group of studies is that they showed the importance of intra-team relations as factors influencing team performance in general and team innovative performance in particular. Interesting further developments of this strand of research are the findings that also inter-team relations within an organization are relevant for team performance (Ancona & Caldwell, 1992;

Hite & Hesterly, 2001; Katz et al., 2004) and that intra-team relations influence the individual level performance (Allen & Cohen, 1969; Kijkuit & van den Ende, 2010; Sparrowe et al., 2001).

A second relevant stream of research on small groups are psychological studies on work group effectiveness (e.g. performance, satisfaction, leadership effectiveness, affective relations). This literature examines which internal and external factors (inputs) influence group effectiveness through interaction processes and is based on the input-process-output model (IPO). Underlying to this model is the assumption that teams are goal oriented and that their performance varies and can be evaluated (Wittenbaum et al., 2004). Roughly three factors are identified as team inputs: team composition (related to personality, competencies, attitudes and values, demographic diversity, functional diversity, etc.), team characteristics (e.g. interdependence, virtuality, training, team structure, leadership), and organizational or contextual characteristics (e.g. human resource system, openness climate, multiteam systems coordination, cultural influence on teams) (Mathieu, Maynard, Rapp, & Gilson, 2008; Poole et al., 2004; Sundstrom, McIntyre, Halfhill, & Richards, 2000; Wittenbaum et al., 2004).

Team processes, i.e. team interaction processes related to task- and teamwork, mediate the effect of team inputs on team outputs. As team processes have been found to be a generic and wide term, scholars have made the distinction between team processes, which involves members interacting with other members and their task environment, and emergent states, characteristics of a team that represent member attitudes, values, cognitions, and motivations (Marks, Mathieu, & Zaccaro, 2001; Mathieu et al., 2008). Both team processes and team emergent states are mediators. Therefore, the IPO model is turned into an input-mediator-outcome (IMO) model (Mathieu et al., 2008). Examples of formerly studied team processes are planning, organizing, communication, coordination, conflict, motivation, interpersonal trust, confidence building, and affect (Mathieu et al., 2008; Sundstrom et al., 2000; Wittenbaum et al., 2004). Team emergent states that have received significant attention are team confidence, empowerment, team climate, cohesion, trust, and collective cognition (Mathieu et al., 2008).

Within this group of psychological studies concerned with team effectiveness, the studies focusing on team-level predictors of creativity and innovation are particularly interesting. Innovation has become a main objective of funded research since research is seen as a driver of economic growth for policy makers. Innovation implies that researchers not only produce new knowledge, but also turn this knowledge into applications that give economic returns (Anderson, De Dreu, & Nijstad, 2004; Scott & Bruce, 1994). In explaining team innovativeness, team processes and emergent states have been ascribed a prominent role. Specific processes and states

relevant for innovation are innovative team climate (which comprises a shared vision, participative safety, support for innovation, and task orientation), cohesion, internal and external communication, and task and relationship conflict (Hulsheger et al., 2009).

The small group studies have brought forward valuable insights into how individual and team performance is influenced through team processes and team emergent states, and to a lesser extent also trough network structures (Cummings & Cross, 2003; Henttonen, 2010; Hulsheger et al., 2009; Kratzer, Leenders, & Van Engelen, 2010; Mathieu et al., 2008; Reagans & Zuckerman, 2001; Sparrowe, Liden, Wayne, & Kraimer, 2001). Unfortunately, the studies on networks on the one hand and team processes and emergent states on the other hand form rather distinct streams of research. In this way, the relational dimension underlying those team processes and emergent states is ignored. Another shortcoming of the small group research is that team level concepts have been reduced to individuals' perception on these concepts when examining how the team level influences individuals within the team. Hence, this literature fails to conceptualize teams as social structures, which influence the individual's actions. Recently, this has been addressed by a call for addressing team processes as cross-level concepts influencing individual behavior (Chen & Kanfer, 2006; Hirst, van Knippenberg, & Zhou, 2009).

The existing research that had attention for the interpersonal contacts that researchers have, gave insights into the morphology of the networks at the department, university, and discipline level and the relevance of intra-team relations for team innovative performance. However, by reviewing this literature, two major shortcomings can be identified. First, even though it is established that intra-team relations are an important factor influencing the (innovative) team performance (Henttonen, 2010; Hulsheger et al., 2009; Mathieu et al., 2008), the examination of previous research clearly shows a lack of research attention for antecedents of social relations and network structures within research teams. With the eye on practical managerial intervention possibilities for the enhancement of the innovative performance of research teams, it is important to examine factors that influence the relational structure of research teams. Therefore, the first research question of this dissertation is: Which factors influence the presence or absence of intra-team relations and thus influence the relational structure of research teams?

A second shortcomings is that even though there is a large number of studies examining outcomes of social relations and network structures for teams, there is only limited attention for the outcomes for individuals' performance (Sparrowe, Liden, Wayne, & Kraimer, 2001). The studies on the topic are furthermore restricted to the benefits of intra-team relations and are mostly not applied to researchers. Since the networks of researchers span across team borders, it

is relevant to compare the benefits of team relations with the benefits of team external relations. This leads us to the second research question of this dissertation is: How important are team contacts and external contacts for individual researchers' innovative performance?

1.2 A structural network perspective on research teams

This dissertation adopts a structural perspective to discussing antecedents and outcomes of intra-team networks for researchers and research teams. This implies that research teams are conceptualized to be entities (social structures), which comprise individual researchers, but which cannot be reduced to these individuals (Bernardi, González, & Requena, 2006). For example, the social network at the team level is built by combining the intra-team networks of all individuals within a team. However, team level constructs cannot be seen as mere aggregates of individual level constructs, but should be considered as emergent properties of combining the various entities at the individual level (Bernardi et al., 2006; Boudon, 1981; Sewell Jr, 1992). Team characteristics such as cohesion, conflict, hierarchy, etc. are only relevant to examine at the team level and do not make sense when disaggregated to the individual level. Hence, researchers and research teams are two distinct concepts.

Even though distinct concepts, researchers and research teams are also interrelated: teams are created and reproduced by the social actions of researchers, and are a motivation for the actions of researchers. Through this process of structuration, action and structure are reproduced across time and space. Individuals do not blindly reproduce the social structure. Rather individuals have, to some extent, the ability to transform the social structure. Hence social structures such as teams are dynamic rather than static (Giddens, 1984; Sewell Jr, 1992).

The dominant perspective for the study of relational aspects of social structures is the network perspective on social structure, which is grounded within the structuralist theory (Bernardi et al., 2006; Freeman, 2004; Wellman & Berkowitz, 1991). A social network approach on social structure sees the social relations as main structuring force, which organizes and arranges the individuals within a structure (Wellman & Berkowitz, 1991). Even though social networks studies started from a deterministic structural perspective, later studies have acknowledged the agency of individual actors (Emirbayer & Goodwin, 1994; Wellman & Berkowitz, 1991).

In general, a structuralist perspective for examining social interactions is valuable for three reasons (Friedkin & Johnsen, 2011; Katz et al., 2004; Wellman & Berkowitz, 1991). First, it acknowledges that units (be it individuals, team, countries, etc.) should not be studied in isolation. It allows to integrate both internal working and external environment. Second, the existence of

interdependence between the attitudes and behaviors of individuals in a social structure is taken into consideration. More specifically, the attitudes and behavior of an individual is influenced by the attitudes and behavior of other individuals. Third, within a structuralist perspective, the influence of a relationship is mediated by the position within the structure. Not only the direct relations are important, but in addition the arrangement of the larger structure is influential. Limiting oneself to dyadic analysis, one can miss the indirect influence of relationships. For example, the presence or absence of third parties matters for forming trust relations (Burt & Knez, 1995) and the communication between two people differs on whether they are both embedded within the same cluster or in two separate clusters that otherwise do not communicate at all (Burt, 2004; Krackhardt, 1999).

In conclusion, this dissertation adopts a structural network perspective on research teams. Teams are hence conceptualized as a whole of the enduring orderly and patterned relationships between individuals, which structures and is structured by the individual's actions.

1.3 Networks of researchers - antecedents and outcomes

This section brings together the research questions and the theoretical perspective into a conceptual model. By means of this model, the particular conceptual operationalization of the research question is schematically depicted.

The framework (Figure 1.1) consists out of two interrelated levels, the individual level and the research team level. Following the before described theoretical perspective, team level concepts are made up by their individual level counterparts. The interrelatedness of the concepts at different levels is shown by the constituent relations (straight bold reciprocal arrows) in Figure 1.1 (i.e. between team innovation and innovative work behavior, and between intra-team social networks at the individual and team level).

The middle block of the conceptual framework depicts the social structure and comprises three social network concepts. At the top, the team internal social network at the team level is found, which is constituent with the team internal relations the individual researchers have. In addition, researchers are not only embedded within a team network, but also in an organizational network and a research field network. These network are also social structures. Hence, at the individual level, also the concept *social networks team external* is found, referring to those contacts researchers have with researchers outside of the team.

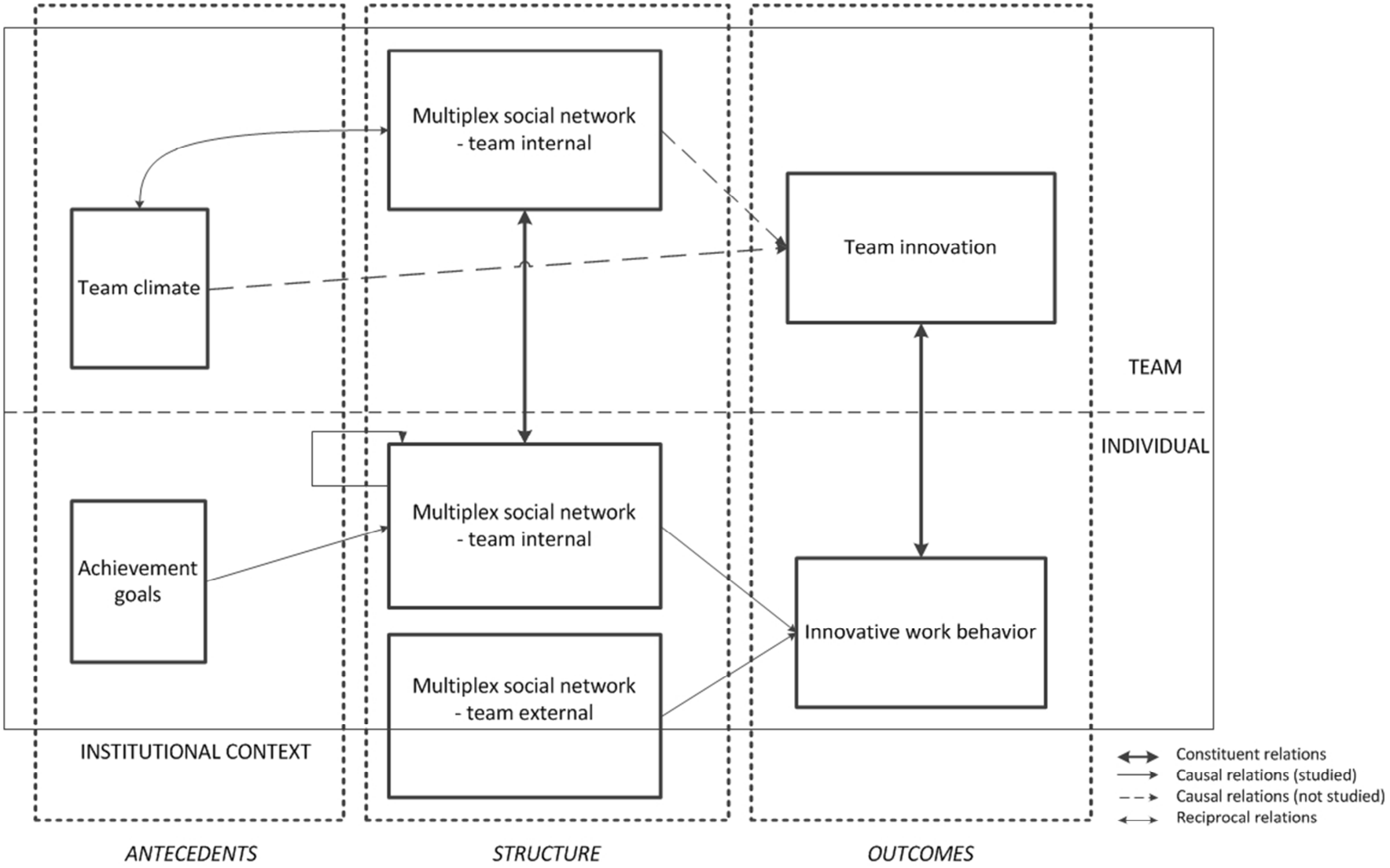
The focus of this dissertation lies on the informal relationships among researchers within these social structures. Already the Hawthorne studies and other classic sociological studies of

Homans, Blau, Gouldner and others showed that informal relationships at work influence worker's well-being and performance (Agneessens & Wittek, 2008; Völker & Flap, 2004). In addition, the informal relationships among employees, rather than the formal relationships (i.e. the relations as defined by the organizational charts), were found to be the true drivers (or hindering factors) of organizational performance in general (Cross & Parker, 2004) and team innovative performance in particular (Henttonen, 2010; Kratzer et al., 2005).

Rather than focusing on one type of informal relationships (e.g. technical communication, or advice giving relationships), the relationships are in this dissertation conceptualized as multiplex, that is dyadic interactions are based on more than one type of social relation. In total six relationships are examined, which are either instrumental (advice giving, cooperation) or affective relationships (trust, distrust, friendship and dissonant relationship). Both instrumental and affective relationships are present in the existing literature, even though most studies focus on instrumental relationships. Within the affective relations, there is attention for negative relationships. Negative relationships can be defined as "an enduring, recurring set of negative judgments, feeling and behavioral intentions toward another person – a negative person schema" (Labianca & Brass, 2006, p. 597). Negative relationships occur infrequently within organizations: only 1 to 8 percent of the relationships within organizations can be defined as negative. Nonetheless, these relationship are relevant to investigate, as negative stimuli tend to have a greater impact than positive or neutral stimuli. A negative relationship does not always imply an observable or latent conflict, but rather, they should be seen as dislike. This dislike may range from mild (having a negative feeling) to severe (conflict situation). These relationships can influence the behavior of the individuals involved, by causing avoidance and job redesign, and can lead to lower organizational attachment and lower job satisfaction (Labianca & Brass, 2006).

On the left side of the *structure* block, a block indicates the concepts that are examined as antecedents in this dissertation and at the right side of the *structure* block the outcomes. Both blocks are explained step-by-step in the two following subsections. Thereby insight is given into how the two main research questions are addressed in this dissertation and how this builds further on prior research.

Figure 1.1 Conceptual framework concerning antecedents and outcomes of the networks in which researchers are embedded.



1.3.1 Antecedents of social network structures

Since human action is produced by both the structure in which the individual is embedded and by the agency of the individual, both individual and contextual factors are in this dissertation examined as antecedents of intra-team social structures. Factors at the individual level are seen as influencing the individual to choose or reject social partners. These factors are antecedents of the individual social structures which capture the agency of individuals. Factors at the network, team and institutional level are expected to structure the behavior of individuals, thus forming structural antecedents of individual and team social structures. The existing research on antecedents of social relations and network structures is fragmented and diverse (Borgatti & Foster, 2003; Mehra et al., 2001). Even though the research is extensive, the interpersonal relations among researchers are rarely addressed. Since these are the first studies on antecedents of relations and network structures specific for the case of researchers and research teams, it is acknowledged that the four antecedents considered in this dissertation do not form an exhaustive list of antecedents of intra-team relations. The aim of this dissertation is, rather than to provide an exhaustive list, to find antecedents which are relevant in this specifically for researchers and research teams.

Underlying the perspective that human action is shaped in part by the agency of individuals is a rational actor perspective. Individuals are seen in this thesis as actors seeking to fulfill certain self-interests, such as performing well. Thereto they guide their actions in a rather rational way, since individuals will try to set up their relationships in such a way that they access the required beneficial resources and invest in those relationships that help them research their goals (Katz, Lazer, Arrow & Contractor, 2004; Wittek, Snijders & Nee, 2013). Since individuals act in complex social situations not all decision are made after a full rational decision. Instead also the goals, preferences and beliefs of the individuals, which are influenced by the social environment, play a role in decision making and thus in shaping behavior (Wittek, Snijders & Nee, 2013).

At the bottom left corner of the conceptual model, the individual level antecedent achievement goals is found. Achievement goals have been selected as individual level antecedents because this construct has been found to be a strong motivator for behavior in achievement situations (e.g. work environment) (DeShon & Gillespie, 2005) and has been found to be a motivational factor for individuals' innovative performance (Janssen & Van Yperen, 2004). Existing studies on individual level antecedents of work relations have examined demographic characteristics of individuals (such as age, gender, educational level, tenure), which influence the formation of

dyadic relations through processes of homophily (Balkundi, Kilduff, Barsness, & Michael, 2007; Henttonen et al., 2010; Ibarra, 1992; Katz et al., 2004; McPherson, Smith-Lovin, & Cook, 2001; Zenger & Lawrence, 1989). In addition, several studies have also identified individual predispositions (e.g. personality, self-monitoring) as antecedents for individuals' network structures (Burt, Jannotta, & Mahoney, 1998; Kalish & Robins, 2006; Klein, Lim, Saltz, & Mayer, 2004; Mehra et al., 2001). Since there are no clear indications why these formerly studied factors would not be relevant in the case of researchers within research teams, the choice was made to choose factors that complement the existing research by examining other factors – achievement goals - rather than copying existing research for the particular case of researchers.

Conceptually, a certain level of ambiguity remains about whether goal orientation are traits, or rather semi-traits, mental frameworks, beliefs or goals. Nonetheless, this construct is found to influence cognition, affect and behavior associated with task engagement and task performance and more recently also social behavior (Janssen & Van Yperen, 2004; Poortvliet, Janssen, Van Yperen, & Van de Vliert, 2007). More specific, research interest has grown into how achievement goals affect the attitudes and behavior intentions of individuals. Achievement goals are related to the perceptions that individuals hold about the costs and benefits of interacting with others in an achievement context. Traditionally, a learning and performance goal are distinguished. A learning goal makes that individuals seek to develop one's ability by acquiring new skills and mastering new situations. A performance goal leads the attention of individuals towards demonstrating one's ability and gain positive evaluations or favorable judgments about their abilities (VandeWalle, 1997).

A second antecedent at the individual level is depicted by the loop going from and to multiplex social team internal networks. Since networks are multiplex, it can be examined whether some relation types are necessary for the formation of other types of relations. Several studies have already found that certain relations can be seen as antecedents of others (Allen & Cohen, 1969; Casciaro & Lobo, 2008; Ellwardt, Steglich, & Wittek, 2012; Lazega & Pattison, 1999). For example, both Casciaro and Lobo (2008) and Allen and Cohen (1969) found that engaging in an instrumental relation is dependent on the present affective relation. In this dissertation, the case of trust relations as antecedents for cooperation relations is examined. The relation between trust and cooperation is often briefly mentioned in the trust literature that examines the performance outcomes of trust (Dirks & Ferrin, 2001), but is not yet empirically studied. The argument goes back to social exchange theory, which postulates that to overcome the risks and uncertainty related to social exchanges such as cooperation, individuals need to trust their exchange partner.

Since cooperation is a relevant work behavior of researchers and trustful cooperation has been found to be beneficial for knowledge transfers (Hansen, 1999; Levin & Cross, 2004), studying the association between trust and cooperation relations is particularly interesting in the case of researchers and research teams.

A third antecedent in the top left corner is the team level antecedent team climate. The psychological small group research has found a number of team interaction processes related to task- and teamwork. However, the underlying relational structure of these processes was never examined. In addition existing research had little attention for other team level antecedents of social relations. As an exception, Hoegl, Parboteeah, and Munson (2003) examined individuals' perceptions of team-level characteristics (e.g. the networking preference, the importance of networking for project success, the networking resources) as team-level antecedents. In this dissertation, team climate is examined as antecedent of team network structures. Climate in general refers to the shared perceptions that individuals hold regarding aspects of the work environment (i.e. the job content and organization, co-workers, leaders, expectations concerning behavior and performance, procedures, etc.) (Anderson & West, 1998; James et al., 2008). Initially climate was an organizational level construct, but since then, team constructs have been developed as well. A team climate is the aggregation of the team members' individual psychological climates, that are the individual team members' individual perceptions regarding aspects of the work environment (Anderson & West, 1998; James et al., 2008; Mathieu et al., 2008). As the measurement of a generic climate is problematic to measure, scholars have focused on a specific dimensions of team climate, such as a safety climate, a creativity climate, an affective climate, etc. (Anderson & West, 1998; Mathieu et al., 2008). In this dissertation, the focus lies on team innovation climate, which comprises shared vision, interaction frequency, task orientation, participative safety, and support for innovation. Former research studied how, through psychological processes, team climate perceptions and network structures shape each other (Schneider & Reichers, 1983; Schulte, Cohen, & Klein, 2012; Young & Parker, 1999; Zohar & Tenne-Gazit, 2008).

A final antecedent of intra-team relations considered in this dissertation is the institutional context in which teams are embedded. Research teams in general differ from other work teams within organizations in that the leadership is less rigid in research teams and members have a certain participation in aspects of the management. Furthermore, research teams are embedded within two types of institutional context, an academic or an industrial one. Academic research teams differ from industrial ones in several respects. As mentioned in the introduction, academic

research teams center most often around a single professor and consist out of (doctoral)students, technicians, and postdoctoral fellows (Etzkowitz & Kemelgor, 1998; Hagstrom, 1964). Even though professors are members of a department and faculty, they have the freedom and capacity to outline their own research programmes (Bailyn, 1985; Etzkowitz & Kemelgor, 1998). Since doctoral students and postdoctoral fellows have their own well-defined projects, formal collaboration and shared tasks among the members are limited within academic research teams. The only type of collaborations that is formalized is the hierarchical relation between the professor and his students (Etzkowitz & Kemelgor, 1998; Hagstrom, 1964). However, informally, academic researchers can collaborate within their research team. In addition, collaborations are sought with other members of the research community (Bush & Hattery, 1956; Etzkowitz & Kemelgor, 1998; Hagstrom, 1964; Katz & Martin, 1997). In contrast, within the industry, research teams are embedded within the larger organization and researchers are expected to show loyalty to the organization, conform with established policies and procedures, and follow the line of research as outlined by the organization (Bailyn, 1985; Blume, 1974; Box & Cotgrove, 1966; Hagstrom, 1964; Sauermann & Stephan, 2010). Within industrial research teams, researchers work together on the defined goals, sharing tasks with other team members. Hence, teamwork practices differ between the industrial and academic context. While in an academic team, the formal collaborations are limited and informal collaborations depend on the overlap of research topics of the doctoral students and postdoctoral fellows, in industrial teams, collaboration among team members is more formally delineated due to the division of tasks among the members.

As visible in Figure 1.1, the institutional context encompasses all other concepts of this dissertation. The differences described between the institutional contexts here are conceptualized to be associated with team climate, achievement goals, network structures, team performance and individual performance between academic and industrial researchers and research teams. In comparison to industrial teams, academic teams are more individualized and often miss a common team goal. Hence, individual goals (such as achievement goals) and individual level performance are expected to be more pronounced in academic teams, while industrial teams focus more on team goals and team performance. The level of instrumental relationships such as cooperation are expected to be lower within academic teams than in industrial teams due to the differences in formalization of these relations. Finally, it is expected that there will be a more active management of the team climate in industrial teams than in academic teams. Each study will examine whether and how these differences exist. It is presumed that there are inequalities between an industrial and academic context in the access to beneficial network structures due to

differences in team climate and achievement goals, which can result in inequalities in the access to performance benefits from these networks.

1.3.2 Outcomes of social network structures

Besides examining antecedents of social relations and social structure, this dissertation argues that social relations do not only bring forward social capital benefits for research teams (which is already established in former research), but also for individual researchers. In particular, the second main objective of this dissertation is to examine which benefits social relations, both within and outside of the team, bring for individual researchers' innovative performance. The focus in this dissertation lies on innovative work behavior, a relevant work behavior for researchers. Innovative work behavior is defined as the behavior related to the generation, promotion, and implementation of new ideas (Janssen, 2000). Innovative work behavior is found in the conceptual model in the right block. Team innovation, which appears in the conceptual model above innovative work behavior, is the team level innovation construct that is interrelated with the individual level innovative behavior.

Within the psychological innovation literature, the social psychology perspective focusses on the social dimension of innovation by studying what motivates and enables individuals to innovate (Scott & Bruce, 1994). Starting with the theoretical work of Amabile (1983), Woodman, Sawyer and Griffin (1993) and Scott and Bruce (1994), a small but steadily growing empirical line of research has developed. Innovative work behavior is in this perspective not only depending on the researcher's technical knowledge and skills (human capital) but also the relations he or she has with researchers and other professionals (social capital) (Bozeman & Corley, 2004; Lee & Bozeman, 2005; Scott & Bruce, 1994; Shalley, Zhou, & Oldham, 2004). Even though valuable insights are already gained from this literature into the role of supervisors and coworkers on the intrinsic motivation of individuals to be innovative (Scott & Bruce, 1994; Shalley, Zhou, & Oldham, 2004), the research only analyzes the direct impact of social relations. In that way, the social influence that researchers experience is not fully captured. This shortcoming is addressed in this dissertation by examining social capital for innovative work behavior through a structuralist lens (i.e. a network approach on social capital).

Social capital has by now become a classic sociological concept. Nonetheless, the conceptualization and operationalization of the concept stays open for discussion. The founding father, Pierre Bourdieu (1986, p. 51) defines the concept as *"the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalised relationships of*

mutual acquaintance and recognition – or in other words, to membership in a group – which provides each of its members with the backing of the collectivity-owned capital, a 'credential' which entitles them to credit, in the various senses of the word". As social capital has its roots in social networks and social relations, Lin (2005) argues that social capital should be measured in relation to that, proposing a network theory of social capital. In this view, social capital is operationalized as the embedded resources of a social structure.

In general, people will succeed better in attaining goals when they have more access to social capital. Studies have examined the effectiveness of social capital in a diverse range of areas, among which occupational attainment, occupational success, minorities research, school success of children and economic performance of countries (Völker & Flap, 2004). In this study, the focus lies on work-related relations and how these bring returns for work-related performance. Hansen, Podolny and Pfeffer (1999) developed a task contingency perspective on corporate social capital, pointing out that the value of a certain social network structure depends on the task executed and thus that a well-defined network structure can be beneficial for certain tasks, but detrimental for others. For example, innovative tasks require a unique configuration of the network. Kijkuit and van den Eynde (2007, 2010) found in detail that the network structure and content of the network, and thus also the individuals involved, differ depending on the phase of development (idea generation, development and evaluation) in order to contribute to the quality of the idea. Thus, social capital is operationalized as a goal-specific construct.

Recently, several scholars have pointed out the biased focus on the positive effects of social relations, ignoring the downturns (Gabbay & Leenders, 2002; Gargiulo & Benassi, 2002; Labianca & Brass, 2006; Moerbeek & Need, 2003). However, colorful terms have been coined to identify these detrimental effects, e.g. sour social capital, social liability or the dark side of social capital (Gabbay & Leenders, 2002; Gargiulo & Benassi, 2002). Social structure can prohibit and obstruct actions by 1) constraining the behavior of actors due to too strong social relations, and 2) by limiting opportunities due to negative relationships (Gabbay & Leenders, 2002). For example, the social structure can be constraining when limiting the ability to change the composition of the network. These changes are necessary when the current resources in the network are no longer adequate to meet the needs of the actor (Gargiulo & Benassi, 2002).

Several authors have proposed different theories concerning the optimal configuration of and position within the social structure. Coleman (1988), for instance, emphasized the role of closure in social networks, as such networks were most suited to generate social support, exert social control and generate cohesion. However, on the downside, this type of network could lead to

loss of autonomy, social pressure to conform and group think (Burt, 1992; Kijkuit & van den Ende, 2010; Kratzer et al., 2010). Granovetter (1985) already pointed out that these strong relationships typical for networks with high closure are not well suited for acquiring or disseminating information, and that weak ties are better suited for this purpose as they reach a more heterogeneous public. Relying on Simmel's analysis of the triad, Burt (2000) develops the concept of structural holes and redundancy. Being able to bridge structural holes in the network gives individuals a competitive advantage and provides additional social capital because of the brokerage role, which may benefit individual group members. However, Krackhardt (1999) points out that in some cases connecting two actors, who are not mutually connected, with a third actor can be detrimental for the actor who possesses the middle position. More specific, this is the case when the triad is formed by Simmelian ties – ties embedded in different cliques. These Simmelian ties brings constraints and restrictions for the actor by the different and often conflicting norms and rules from the different cliques. Well performing industrial research teams have been found to have a rather closed intra-team network, with only a number of structural holes present. Structural holes are for these teams valuable when they are present in the network of relationships that team members have with outsiders (Reagans et al., 2004; Reagans & Zuckerman, 2001).

These theories on the optimal configurations of networks have been critiqued because they assume that resources are uniformly distributed across the network. Lin (1999) for example states that "network locations should facilitate, but not necessarily determine, access to better embedded resources". This critique leads to an alternative view on how social networks bring about benefits, namely through the embedded resources. The resources within a network come from resourceful alters who can be distinguished by characteristics like wealth, power and status (Gabbay & Leenders, 2002; Lin, 1999). The activation of resources embedded in the relationship or possessed by one's actors depends on the type of relationships and thus on the roles of both ego and alters (Völker & Flap, 2004). For instance, one can ask different things of friends than of advisors, and a senior researcher can often provide better information and advice than someone who recently started.

Based on the embedded resources, several dimensions of social capital can be distinguished: 1) personal skills social capital with instrumental resources, 2) expressive social capital with social support and control, and 3) prestige and political social capital with resources form influential others (Van der Gaag & Snijders, 2005). Personal skills social capital refers to instrumental resources which can be obtained through contacts with others. Specific for researchers, relevant

resources are information and knowledge. For innovation these flows of information and knowledge are important, as they are the seeds for new ideas. Most studies on social relations within the work environment deal with task-related or instrumental social capital, resulting from fulfilling appointed work functions (Henttonen, 2010; Kratzer et al., 2005). In addition, expressive social capital exists. Social relations can lead to social support and social control (Nahapiet & Ghoshal, 1998), which can be decisive elements in the different stages of innovation. For example, social support may encourage you to develop an idea, or to promote your idea to colleagues or supervisors. At the team level, social support, and social control, can lead to group cohesion and the establishment of group norms. This social aspect of social networks may be beneficial as it creates a context or climate for innovation. Finally, being connected to influential persons can enhance an individual's prestige, leading to more opportunities and higher job success (Lin, 2005; Van der Gaag & Snijders, 2005). Social ties may also exert influence on the agents who play a critical role in decisions involving the actor, what is called political social capital. Prestige and political social capital are less frequently studied. However, they are important in the idea promotion stage when considering the need of mobilizing persons and creating coalitions in favor of a proposed idea (Kijkuit & van den Ende, 2007, 2010; Ohly, Kase, & Skerlavaj, 2010; Van der Gaag & Snijders, 2005).

Following the embedded resource perspective and taking into account that social capital benefits are goal-specific, the benefits of social resources accessed through internal and external groups of contacts for researchers' innovative work behavior are examined in this dissertation. However, an alternative way of approaching the relationship between innovative work behavior and social relations and networks is to examine innovative work behavior as an antecedent of social relations and network structures. It can be argued that individuals with high innovative work behavior are highly attractive people to interact with because of the valuable resources they hold. Similarly, it could be argued that through the process of homophily, cliques with high and low performing individuals would come into existence within the networks. All these approaches regarding the relationships between innovative work behavior and social relations are valid. The only way to disentangle the relative value of each of these processes is through the study of longitudinal data. However, this falls outside the scope of this thesis.

1.4 Overview of the empirical studies

The conceptual framework is empirically investigated in four empirical research papers, which are indicated on the conceptual framework (see S1 to S4) in Figure 1.2. In this section, the overall objectives of the empirical studies, which form chapter 3 to 6 of this dissertation, are explained.

The first three studies focus on the antecedents of individual and team level social networks and the last study examines the outcomes of individual social networks within and outside of the team.

Study 1 – The Social Consequences of Achievement Goals Within Work Teams.

The first study examines achievement goals as individual level antecedents of ego-network structures. The implications of achievement goals with regard to workplace social relations have been mainly addressed using experimental studies. This study argues that the influence of an individual's achievement goals on his/her social relations is context specific. Therefore, the relationship between achievement goals and social relations is examined in a real-world work team setting. The effects of achievement goals are studied by focusing on two characteristics of the immediate network environment of individuals (i.e. degree and constraint) for instrumental, positive affective and negative relations.

Study 2 - A Network Perspective on Team Innovation Climate.

The second study deals with two team level constructs, team climate and team network structure, which have been developed within two distinct disciplines. Within research teams, teamwork is crucial for the successful completion of research tasks. Team innovation climate, which is a social-cognitive construction of the in-role work behaviors, is therefore expected to relate to team network structures. The goal of establishing congruency between team network structures and team climate aspects is in the first place to gain a better understanding about which social behaviors are stimulated or constrained through innovation team climate. Determining the extent of overlap and complementarity between the concepts also leads the way to the integration of the research perspectives towards research that combines the team climate and network perspective.

Study 3 - Trust for Cooperation? A Contextual Approach on Multiplex Trust-Cooperation Relations.

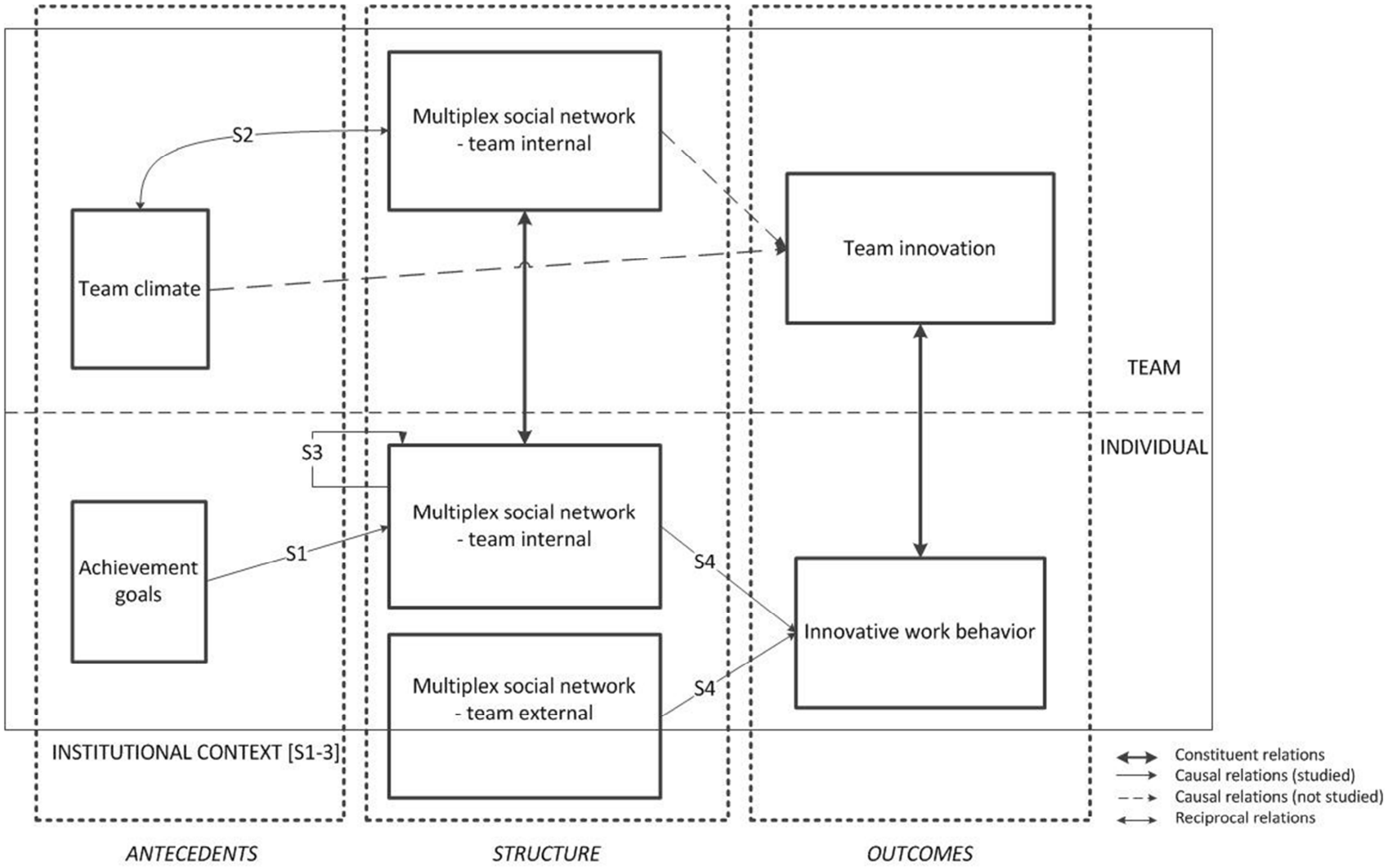
The third study examines a network-level antecedent by examining the multiplexity between teams' trust and cooperation networks. The dominant perspective in the trust literature states that high levels of interpersonal trust within a team stimulate cooperation. However, there are indications that trust does not always result in higher cooperation and performance. This study argues that there are contextual factors which influence the multiplexity between trust and cooperation. The examined contextual factors are dimensions of team innovation climate

(participative safety, interaction frequency, support for innovation) that have been found in former research to relate to intra-team relations.

Study 4 - Close Versus Distant Network Contacts: Differing Social Capital Returns for Researchers' Innovative Work Behavior.

The fourth study addresses outcomes of the social embeddedness of researchers within a team, organization and research field. The aim of this paper is to identify which types of contacts give social capital benefits for innovative work behavior. In line with the three identified social structures, three types of contacts are distinguished: team contacts, internal bridging contacts (within organization, but outside of the team) and external bridging contacts (from within the research field). As social capital is goal-specific, the outcomes were examined for three distinct aspects with innovative work behavior: idea generation, idea promotion and idea implementation. The paper argues that different types of contacts give access to certain specific social resources, and hence deliver different social capital returns. The contributions of the instrumental and emotional resources from each of the types of contacts are examined. Based on knowledge management theory and social capital theory, hypothesis are formulated concerning the contributions of the instrumental and emotional resources of the three types of contacts.

Figure 1.2. Conceptual framework concerning antecedents and outcomes of the networks in which researchers are embedded with indication of the empirical studies (S1-S4).



2. DATA AND METHODOLOGY

This second chapter of the dissertation addresses the dataset and methodology used in the four empirical studies. Since there are no publicly available datasets on the networks of researchers and research teams, all empirical studies use self-collected data. This chapter provides more in-depth information on the dataset, giving attention to the sample procedure, the data collection process, and the survey instrument. The operationalization of the main variables is discussed in detail. Afterwards, a description of the dataset follows, focusing on the team level composition of the dataset and the respondents' socio-demographic and professional career characteristics.

2.1 Sample design

Since there does not exist a list of academic or industrial research teams present, nor of which organizations actively undertake research activities within Flanders, selecting a random sample of research teams was not possible. Therefore, an alternative procedure was used to identify teams. First, research fields were identified that could provide research teams. The research fields needed to meet three criteria: 1) the field should be part of a research intensive economic sector, 2) the economic sector should be large enough in Flanders to have sufficient research teams; and 3) Flemish universities should have sufficient research groups in the selected field. Fields with only academic or industrial research teams were not wanted, as this would make the comparison between the industrial and academic research groups problematic. Finally, four research fields - i.e. chemistry, pharmaceuticals, biotechnology, and IT - were selected that met the criteria. For getting in contact with research teams within these research fields, we relied on online searches for companies, organizational websites, LinkedIn, and personal contacts of stakeholders of the VIGOR project (i.e. the project in which this research is embedded).

Through this non-random convenience sample procedure, 37 teams were found that wanted to participate in this study. In total 520 questionnaires were distributed to team leaders and members. 428 of these questionnaires were completed and returned (response rate is 82.3%). In Table 2.1, the distribution of the teams and respondents is found per research field and institutional context. With 28 academic teams versus 9 industrial teams, three forth of the sample consists of academic teams.

Table 2.1

Number of participating teams and respondents per research field

	University	Industry
Field		
-chemistry	9	3
-pharmaceuticals	4	2
-biotechnology	11	1
-IT	4	3
Total number of teams	28	9
Total number of respondents	353	75

2.2 Data collection

All fieldwork took place between March 2011 and July 2012. The procedure for gathering data was as follows. The leaders of the teams were contacted by e-mail with a brief project information sheet and were asked whether they and their team wanted to participate. As incentive to participate, the results of the studies are shared with the teams. After agreeing to participate, a meeting was set up with the team leader to first discuss the project in more detail and answer any questions and second let the team leader complete the questionnaire on paper (approximately 60 minutes to complete). For each team member, a paper copy of the questionnaire (approximately 45 minutes to complete) was handed over to the team leader, who distributed the copies among the other team members. After completion, the team members inserted their questionnaires into enclosed blank envelopes. They could deliver the envelope back at their leader or could send it directly to our office. In order to give the team members enough time to complete the questionnaire at their own pace and time, team members had around three weeks before the envelopes were collected from the team leaders.

2.3 Sample description

In this section, a description of the sample is given. First, the team characteristics are examined. Afterwards, the demographic characteristics of the respondents and the distribution of these characteristics over the teams is described. In a final step, differences between academic and industrial researchers and teams are discussed.

Table 2.2

Team characteristics and team demographic composition

	Institutional context	Number of members (including leader)	Team age (in years)	Response rate (%)	mean general tenure	mean team tenure	% males	% masters	% doctors	% Belgians	% Europeans (excl Belgians)	% non-Europeans
1	academic	4	11	1.00	7.13	5.10	1.00	0.75	0.25	1.00	0.00	0.00
2	academic	6	2	0.67	4.88	1.15	0.50	0.50	0.17	0.00	0.50	0.50
3	academic	6	11	1.00	6.33	3.17	0.50	0.83	0.17	0.50	0.17	0.33
4	academic	6	8	1.00	12.83	7.58	0.50	0.33	0.50	0.33	0.33	0.33
5	academic	6	3	0.83	6.50	1.56	0.60	0.33	0.50	0.80	0.20	0.00
6	academic	8	12	1.00	6.13	4.50	0.88	0.50	0.50	0.75	0.25	0.00
7	academic	9	6	1.00	4.32	3.01	0.56	0.67	0.33	1.00	0.00	0.00
8	academic	9	6	1.00	4.90	2.96	0.33	0.89	0.11	1.00	0.00	0.00
9	academic	9	14	1.00	16.13	6.85	0.33	0.22	0.44	0.78	0.11	0.11
10	academic	10	16	1.00	6.75	4.83	0.70	0.70	0.30	0.60	0.00	0.40
11	academic	10	7	1.00	6.48	5.63	0.80	0.70	0.30	0.60	0.20	0.20
12	academic	11	30	0.91	4.25	3.35	1.00	0.64	0.18	0.78	0.00	0.22
13	academic	13	4	0.77	4.70	3.87	0.70	0.62	0.15	0.70	0.20	0.10
14	academic	13	3	0.77	4.61	1.95	0.50	0.23	0.46	0.30	0.70	0.00
15	academic	13	8	0.62	8.75	6.25	0.50	0.15	0.31	1.00	0.00	0.00
16	academic	14	18	0.93	7.96	5.71	0.38	0.43	0.36	0.92	0.08	0.00
17	academic	16	9	0.88	6.69	3.35	0.57	0.44	0.25	0.64	0.21	0.14
18	academic	17	6	0.88	5.79	3.66	0.53	0.47	0.41	0.67	0.27	0.07
19	academic	17	23	0.88	11.72	9.79	0.87	0.29	0.59	1.00	0.00	0.00
20	academic	18	15	0.56	9.75	5.64	0.50	0.28	0.17	0.60	0.20	0.20
21	academic	21	13	0.76	8.31	7.13	0.50	0.38	0.38	0.94	0.06	0.00
22	academic	23	5	0.65	5.77	3.27	0.64	0.39	0.22	0.43	0.43	0.14

Table 2.2 continued.

	Institutional context	Number of members (including leader)	Team age (in years)	Response rate (%)	mean general tenure	mean team tenure	% males	% masters	% doctors	% Belgians	% Europeans (excl Belgians)	% non-Europeans
23	academic	24	12	0.88	6.00	4.32	1.00	0.46	0.33	0.95	0.00	0.05
24	academic	26	12	0.81	10.07	6.48	0.42	0.15	0.19	0.94	0.06	0.00
25	academic	27	6	0.74	9.74	3.58	0.60	0.44	0.30	0.80	0.10	0.10
26	academic	28	26	0.54	11.40	7.07	0.60	0.29	0.25	0.53	0.33	0.13
27	academic	32	4	0.81	7.24	4.05	0.65	0.44	0.25	0.60	0.36	0.04
28	academic	38	9	0.87	6.02	3.91	0.33	0.58	0.26	0.64	0.15	0.21
29	industrial	3	9	1.00	10.00	4.00	1.00	0.00	0.67	1.00	0.00	0.00
30	industrial	6	7	1.00	16.33	3.42	1.00	0.17	0.67	1.00	0.00	0.00
31	industrial	9	1	1.00	20.00	16.00	1.00	0.00	0.56	0.63	0.38	0.00
32	industrial	9	14	1.00	15.00	3.00	1.00	0.89	0.11	1.00	0.00	0.00
33	industrial	9	22	1.00	17.67	16.28	0.89	0.00	0.33	1.00	0.00	0.00
34	industrial	11	5	1.00	6.74	1.60	0.36	0.36	0.45	0.82	0.18	0.00
35	industrial	12	1	0.67	12.13	6.31	1.00	0.00	0.67	0.38	0.00	0.63
36	industrial	12	5	1.00	13.40	6.60	0.42	0.08	0.17	1.00	0.00	0.00
37	industrial	15	6	0.60	10.11	6.44	0.78	0.33	0.00	1.00	0.00	0.00
M		14	10	0.87								
SD		8.28	6.93	0.15								
Minimum		3	1	0.54	4.25	1.15	0.33	0.00	0.00	0.00	0.00	0.00
Maximum		38	30	1.00	20.00	16.28	1.00	0.89	0.67	1.00	0.70	0.63

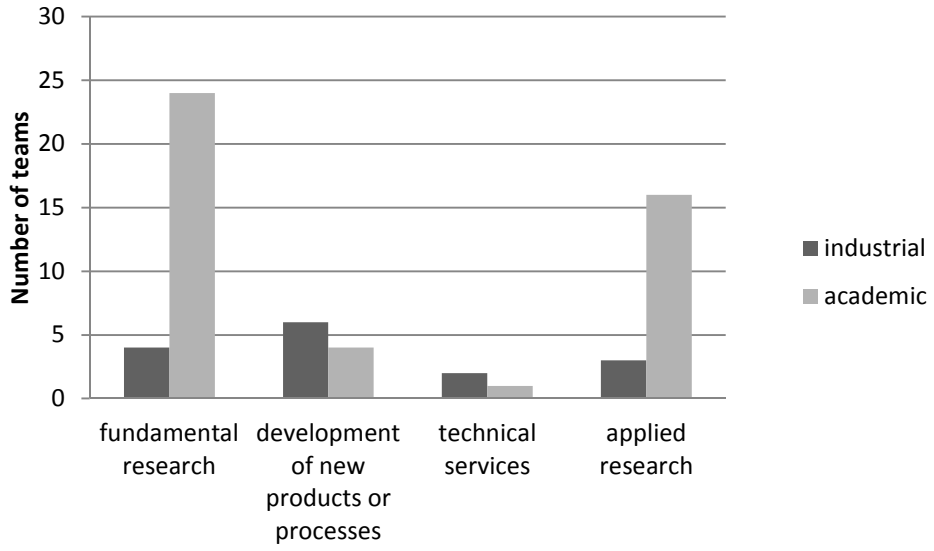
Team characteristics

The first four columns of Table 2.2 show characteristics of the teams of the dataset. On average the teams are made up out of 14 researchers (*SD*=8.28), with the smallest teams consisting of 3 and the largest of 38 researchers. The lowest response rate was 54%, and the mean response rate 87% (*SD*=0.15). Team size and response rate correlate moderately negative (r=-.49), implying that larger teams tend to have a lower response rate. Finally, the teams of the sample are a mix of old and new teams, with teams only one year formed up to teams existing 30 years (*M*=10; *SD*=6.93).

Figure 2.1 gives an overview of the types of research executed by the teams in the sample. Team leaders could choose more than one possibility. A large majority of the academic research teams are occupied with fundamental research, and more than half with applied research. Only a small number of academic teams develop new products or processes or give technical services. Industrial teams are mostly occupied with the development of new products. Around half of the industrial teams executes fundamental research. A couple of industrial teams occupy themselves with applied research or giving technical services.

Figure 2.1

Number of teams executing the specified types of research (teams could indicate multiple types)



Demographic characteristics respondents

The median researcher that participated in our study is a Belgian male researcher of 29 years old, with six years of work experience and working three years in the team that was examined. However, this median researcher does not cover the large diversity in respondents present in our

sample. The respondents range in age from 21 to 67 years, with an average of 32 years (*SD*=8.49). The general tenure of the respondents ranges from 0 to 45 years (*M*=8.68; *SD*=8.45) and the team tenure from 0 to 41 (*M*=5.25; *SD*=6.26). 37% of the respondents is female. The respondents have mainly a masters diploma (49%) or doctorate (38%). The largest group of respondents (75%) have the Belgian nationality. More detailed information about the gender, education level and nationality can be found in Table 2.3.

Table 2.3

Demographic characteristics of the respondents

Variable	Category	Frequency	Percentage
Gender	Male	267	37.2
	Female	158	62.8
	Missing	95	
Education	Secondary	4	0.9
	Professional bachelor	31	7.3
	Professional master	22	5.2
	Academic master	207	48.9
	Doctorate	159	37.6
	Missing	97	
Nationality	Belgian	315	75.0
	European	64	15.2
	Non-European	41	9.8
	Missing	100	

Not only at the individual level is there demographic heterogeneity. Also at the team level, there is some remarkable diversity considering the demographic composition. In columns 5 to 12 of Table 2.2, information on the demographic parameters for each of the teams is provided. The average general tenure of the members of the teams ranges from 4.25 to 20.00 years, and the average team tenure from 1.15 to 16.28. Considering gender diversity, eight teams consist out of only males. Seven teams have a balance, with 50% males and thus 50% females. Another seven teams have more females than males, with the largest proportion of females being present being 77%. Remarkably, no teams exists out of 100% females. The percentages of masters and doctorate holders per team differs strongly among teams. Some teams do not have any members with a masters diploma or doctorate, while others have as much as 89% masters or 67% doctorate holders. In addition, the lowest percentage of masters and doctorate holders combined

is 25%, while the highest is 100%. Finally, teams in the sample are diversely composed considering the nationality of the members. Eleven teams consist out of 100% Belgians. In contrast, five teams have less than 50% Belgians, with one team even consisting of all non-Belgian members.

Differences between the academic and industrial context

At the team level, the differences in age, and size are examined. The ages of the academic research teams ranged from 2 to 30 (*M*=10.7; *SD*=6.99) and the size of the industrial teams from 1 to 22 (*M*=7.78; *SD*=6.65). This small difference in mean between academic and industrial research teams are not significant, t(35)=1.09, p=.281. The average size of the industrial team is 10 (*SD*=4) and of the academic teams is 16 (*SD*=9). This difference is size is significant t(33.03)=2.90, p=.007. Thus, academic teams are larger than industrial teams.

At the individual level, academic researchers are found to be on average younger (*M*=31.06; *SD*=7.87) than industrial researchers (*M*=37.92; *SD*=9.00), t(99.80)=-6.12, p=.000. Industrial researchers have a significantly higher average tenure (*M*=13.49; *SD*=8.97) than academic researchers (*M*=7.60; *SD*=7.95), t(100.27)=-5.21, p=.000. In addition, industrial researchers have also a longer tenure within the team (*M*=7.51 ; *SD*=8.10) than academic researchers (*M*=4.77; *SD*=5.69), t(85.25)=-2.71, p=.008. Thus, academic researchers have been found to be on average significantly younger, with a lower general and team tenure.

On average 60% of the academic researchers are male, in comparison to 78% of the industrial researchers. This difference is significant: t(123.14)=-3.29, p=.001. Academic researchers had in 43% of the cases a master diploma (*SD*=.50) and in 30% of the cases a doctorate (*SD*=.46). In contrast, 22% of the industrial researchers had a master diploma (*SD*=.42) and 35% a doctorate (*SD*=.48). The differences for master diplomas are significant between the two groups, t(137.16)=4.17, p=.000, but for doctorates not, t(518)=-.95, p=.344. Finally, more industrial researchers (*M*=86.49; *SD*=.34) than academic researchers (*M*=72.54; *SD*=.45) have the Belgian nationality. This difference is significant t(131.52)=-2.99, p=.003. In contrast more academic researchers (*M*=17.05; *SD*=.38) than industrial researchers (*M*=.07; *SD*=.25) have a European (non-Belgian) nationality. Also this difference is significant, t(151.59)=2.89, p=.004. Finally, there are more academic researchers (*M*=.10; *SD*=.31) than industrial researchers (*M*=.07; *SD*=.25) with a nationality from outside Europe. However, this difference is not significant, t(123.31)=1.08, p=.281. Thus, academic teams have a lower percentage of males, researchers with

a Belgian nationality, and a higher percentage of researchers with a European (non-Belgian) nationality and with a master diploma.

Furthermore, three types of research team outputs are considered: patents (including patent applications), commercial products and publications. The industrial teams have on average 2.11 (*SD*=1.90) and the academic teams 3.68 (*SD*=5.31) patents. A t-test shows the difference between these values is not significant t(35)=-.86, p=.395. Considering commercial products, industrial teams have on average 8.78 (*SD*=14.33) products and academic teams on average 2.36 (*SD*=7.69). Also this difference is not significant: t(9.52)=1.29, p=.229. Academic teams do have significantly more academic publications in journals (*M*=40.29; *SD*=25.60) than industrial teams (*M*=1.67; *SD*=2.55), t(28.60)=-7.86, p=.000. Considering team outputs, academic teams only differ from industrial teams in that they have more academic publication in journals.

Finally, research teams can collaborate formally with other research teams. Considering the collaborations among institutionally the same types of teams (that are academic teams with academic teams and industrial teams with industrial teams), academic teams have a significantly higher number of contacts (*M*=15.89; *SD*=14.28) than the industrial teams (*M*=3.11; *SD*=2.85), t(35)=-2.64, p=.012. In contrast, the number of relationships among academic teams and industrial teams does not differ significantly between industrial teams (*M*=4.00; *SD*=4.00) and academic teams (*M*=4.64; *SD*=4.96), t(35)=-.35, p=.727.

2.4 The questionnaire

After an extensive examination of the literature at the intersection of networks of knowledge workers, innovation, individual organizational behavior and organizational studies, main topics of interest were identified and incorporated into a questionnaire. To address the above defined research topics, four types of data were needed: individual characteristics, team characteristics, team networks, and team-external relations. All types of data were collected from individual members (including leaders) from the research teams. The individuals completed questions on their characteristics, their perceptions of team characteristics, and on the relationships they have with other team members and external researchers. Because team network information was gathered, the questionnaires were not anonymous. The questionnaires were available in Dutch and English. The questionnaires comprised the following subsections (in the order of the questionnaire):

I. SOCIO-DEMOGRAPHIC CHARACTERISTICS

Gender, age, nationality.

II. PROFESSIONAL CAREER

Educational level, general tenure, team tenure.

III. RELATIONSHIPS WITHIN THE TEAM

Rosters with questions concerning the cooperation, advice, feedback, work related disagreement, trust/distrust and friendship relations.

IV. SOCIAL RELATIONS WITHIN AND OUTSIDE OF THE TEAM

Resource generator questionnaire (based on Van der Gaag, Lionarons, & Hutten, s.d.)

Number of external ties per group of contacts

V. JOB SATISFACTION, WORK ATTITUDES AND PERSONALITY

13 items goal orientation (VandeWalle, 1997)

10 items big 5 (Gosling, Rentfrow, & Swann, 2003)

18 items self-monitoring (Snyder & Gangestad, 1986)

3 items job satisfaction (Cammann, Fichman, Jenkins and Klesh (1983) in Anseel & Lievens, 2007)

3 items job autonomy (Spreitzer, 1995)

5 items intrinsic interest (Tierney et al. (1999) in Yuan & Woodman, 2010)

VI. WORK TASKS

5 items innovativeness as a job requirement (Yuan & Woodman, 2010)

VII. THE RESEARCH TEAM

4 items team innovation (De Dreu & West, 2001)

12 items team trust (Mayer et al. (1995) in Farrell et al., 2004)

4 items interaction frequency (Anderson & West, 1998)

8 items participative safety (Anderson & West, 1998)

8 items support for innovation (Anderson & West, 1998)

8 items group conflict (Jehn, 1995)

7 items task orientation(Anderson & West, 1998)

11 items shared vision(Anderson & West, 1998)

4 items group cohesion (Seashore (1954) in Oreilly, Caldwell, & Barnett, 1989)

VIII. INNOVATIVENESS AND PERFORMANCE (ONLY IN THE QUESTIONNAIRE OF THE TEAM LEADERS)

9 items innovative work behavior (Janssen, 2001)

5 items standard job performance (Janssen, 2001)

VII. LEADERSHIP (ONLY IN THE QUESTIONNAIRE FOR TEAM MEMBERS)

17 items charismatic and transactional leadership (CLIO) (De Hoogh, den Hartog, & Koopman, 2004)

2.5 Operationalization of the main variables

In this section, a detailed description is given of the operationalization of the variables of the questionnaire that are present in the empirical studies of this dissertation.

Intra-team relationships

Data on the intra-team relationships were collected by a sociometric procedure. In particular, three rosters were provided to the respondents, in which they could indicate with whom they had certain types of relationships. The usage of rosters is preferred over open-ended name generator questions, since rosters aid recall, reduce measurement error and improve data reliability (Grosser, Lopez-Kidwell, & Labianca, 2010). Rosters presented the respondents with a list of all team members, which the team leaders provided us in advance.

In the first roster, respondents could indicate for each team member (by ticking a box) whether they had a cooperation and/or an advice giving relationship with this person. Above the roster, these relationships were respectively described as follows: "I work directly with this person in order to do my job (e.g. receive input or give output)" and "The last three months, I gave advice to this person". On average, the respondents reported to have 5.18 cooperation relations with other team members (SD = 4.77). Since the sizes of the teams differs, the number of total possible relationships (that is the number of possible alters, which is one less than the team size) differs. To give a more accurate comparison of the number of relations, the different number of possible alters is taken into account by examining the number of relationships as percentage of the total possible relationships. In this sample, the respondents established on average 38 percent of the possible intra-team cooperation relations (SD = 0.33). For advice giving, the respondents reported to have on average 5,03 relationships (SD = 4.77) or 36 percent of the possible intra-team relations (SD = 0.32).

In the second roster, respondents scaled their relationship with each of the team members on a distrust-trust scale. The answers ranged from 1 ('distrust completely') to 7 ('trust completely'). In line with recent research, trust and distrust are conceptualized as two distinct constructs that oppose each other (McKnight & Chervany, 2001; Schoorman, Mayer, & Davis, 2007). In the questionnaire, a single-item measurement of trust and distrust was chosen over a multi-item scale that distinguishes between three dimensions of trust (i.e. ability, benevolence, and integrity (Mayer, Davis, & Schoorman, 1995)). This choice was based on the accepted practice of social network research to use single-item measurements (Ferrin, Dirks, & Shah, 2006; Grosser et al., 2010; Lau & Liden, 2008). A multi-item scale would cause respondent fatigue, especially for large

teams, leading to data with questionable face validity. In Table 2.4, the average number of relationships reported by the respondents for each answer category can be found, both as concrete number and as percentage of the total possible relationships. The respondents thus on average reported to have 0.05 complete distrust relations (*SD* = 0.27) and 3.42 complete trust relations (*SD* = 4.85) with other team members.

Table 2.4

Average number of relationships (as number of relationships and as percentage of total possible relationships) reported on the distrust-trust scale (N = 403)

	Mean number of relations	*SD* number of relations	Mean percentage of total possible relations	*SD* percentage of total possible relations
Distrust completely	0.05	0.27	0.00	0.02
Distrust	0.16	0.50	0.01	0.03
Distrust somewhat	0.56	1.07	0.03	0.06
Neither distrust nor trust	3.59	5.43	0.17	0.20
Trust somewhat	2.83	3.26	0.17	0.17
Trust	5.72	5.20	0.38	0.27
Trust completely	3.42	4.85	0.23	0.28

Finally, in the third roster, respondents indicated their level of friendship with each of the team members. To measure the level of friendship, the different stages of development of relationships into friendship (Van de Bunt, Van Duijn, & Snijders, 1999) were given as categories to rate relations. The respondents could indicate which category best described their relationships with each of the team members. The categories were:

1. Real friend
2. Friendship: people with whom you have a good relationship but whom you would not (yet) call 'real' friends.
3. Friendly relationship: people with whom you regularly have pleasant contact during seminars and breaks. This contact could grow into friendship.

4. Neutral relationship: colleagues with whom you do not have much more in common. However, when you meet each other or are involved in one way or another, the contact is pleasant.
5. Dissonant relationship: people with whom you have an awkward relationship and with whom you certainly do not wish to develop further contact. The contact is uneasy and there is the risk of conflict or argument.
6. Unknown relationship: people you do not know at all, or only by face or name.

In Table 2.5, the average number of relationships reported for each answer category can be found, both as concrete number and as percentage of the total possible relationships. Remarkable is that the respondents on average indicate around 1 team member (SD = 3.62) as unknown to them.

Table 2.5

Average number of relationships (as number of relationships and as percentage of total possible relationships) reported the friendship scale (N=389)

	Mean number of relations	*SD* number of relations	Mean percentage of total possible relations	*SD* percentage of total possible relations
Real friend	1.16	2.36	0.07	0.14
Friendship	3.36	3.37	0.22	0.22
Friendly relationship	5.74	4.79	0.35	0.23
Neutral relationship	5.05	5.22	0.28	0.22
Dissonant relationship	0.36	0.80	0.02	0.05
Unknown	1.31	3.62	0.05	0.12

Instrumental resources and emotional support

For collecting data concerning respondents' access to resources we relied on the Resource Generator. The Resource Generator is a tool for the general measurement of social capital developed by Van Der Gaag and Snijders (2005). In this questionnaire, we adopted questions from the more specific Resource Generator developed to measure the social capital of individuals

working within an organization (Van der Gaag et al., s.d.). In addition, questions were added to meet the need for resources regarding the specific tasks that researchers execute. The full list of 19 resources, in order of appearance in the questionnaire, is given in Table 2.6. References are included for those resources that were not adopted from the Resource Generator for employees within organizations questionnaire. The list includes three types of resources - instrumental [I], emotional [E], and political [P] – which have been defined in previous literature. In addition, five questions relate to interactions with negative connotation [N]. These negative interactions should not be seen as resources, but rather as factors that hamper the use of other social resources.

Table 2.6

Resource generator questions that were included in the questionnaire (in the order of the questionnaire)

Do you know anyone …
…who you can contact for general guidance or who can refer you to others? [I] (Cross, Borgatti, & Parker, 2001)
…who maintains relationships with interesting external organisations? [P]
…who can give you feedback or a good second opinion about your work? [I]
…who you can contact when you have difficulties at work, e.g. when you have difficulties concentrating? [E]
…with whom you're expected to work, but who you would rather avoid? [N] (Jehn, Northcraft, & Neale, 1999; Labianca & Brass, 2006)
…who gives you straight and honest criticism when you do something wrong? [I]
…who can advise you on following interesting, suitable courses or new training? [I]
…who you can contact for aid with the reformulation of a problem in order to come to new insights? [I] (Cross et al., 2001)
…who discourages you in executing your job in a proper way? [N] (Shalley et al., 2004)
…who you can contact to receive answers to rather specific or detailed questions concerning work? [I] (Cross et al., 2001)
…with whom you can discuss conflicts with colleagues or your boss? [E]
…who inspires you to form good ideas whenever you talk to him or her? [I]
…who probably spreads unfavourable information or gossip about you? [N]
…who gives you the confidence to do your job well? [E]
…who is your competitor? [N]
…who you can contact to test the correctness of ideas? [I] (Cross et al., 2001)

Table 2.6 continued.

Do you know anyone …
…with whom you can discuss the recent developments within the field of research and/or product development? [I] (Bouty, 2000)
…who can give you a good reference? [P]
…who opposes you? [N]

Note. Resources without reference are adopted from Van der Gaag et al. (s.d.).

Respondents were asked to indicate whether they had access to these resources through contacts of six different groups of contacts: team members, other researchers within the university (not including team members), colleagues from a different department (non-researchers), researchers from a similar type of organization (i.e. for academic researchers, researchers from other universities and for industrial researchers, researchers from other private organizations), contacts from a different type of organization (i.e. relationships between industrial and academic researchers), family/friends. In addition, respondents had the possibility to indicate that they did not access a resource. The number of contacts they had within each group was asked separately, after completion of the resource generator.

Table 2.7 gives, per type of resource, the percentage of respondents that access the indicated number of resources from the above described groups of contact. In general, researchers access a large number of instrumental, emotional and political resources through contacts with colleagues within their team. However, almost half of the researchers also report to perceive contacts with team members as negative (one or more types of negative relationships).

Furthermore, a large group of researchers accesses instrumental resources from other researchers within their organization (75.5%) and family and friend (67.6%). Less than half of the researchers have access to instrumental resources through contacts from a different type of organization (56.1%), non-researchers from within the organization (38.7%), and contacts from a similar type of organization (34.2%).

Regarding emotional resources, researchers have in many cases access to these resources through family or friends (81.8%). Around half of the researchers access emotional resources through other researchers within their organization. For around 25% or less of the researchers, non-researchers from within the organization, contacts from a similar type of organization and of a different type of organization give access to emotional resources.

Access to political resources is, depending on the type of contacts (excluding the team contacts), available for around 25% to 50%. Other researchers from within the organization give access to these resources for the largest group of researchers (56.2%) and non-researchers from within the organization to the smallest group (32.7%).

Finally, in general few researchers have negative interactions. From all types of contacts excluding team members, the largest group of researchers encounters these interactions by contacting other researchers within the organization (36.3%), while the smallest number of researchers have responded that they encounter negative interactions with family or friends (7.3%).

Table 2.7

Percentages of respondents with the indicated number of resources for each of the groups of contacts per resource type (N varies between 415 and 423)

Instrumental resources						
Number of resources	Team	Other researchers	Non-researchers	Similar type	Different type	Family or friends
0	2.1	24.5	61.2	65.8	43.9	32.4
1	1.4	10.1	14.2	9.2	10.8	18.4
2	0.7	7.0	6.0	6.6	8.3	16.5
3	2.1	8.2	5.5	3.5	7.8	10.6
4	2.8	7.0	2.4	2.6	5.2	7.6
5	2.6	8.7	3.1	3.3	5.2	3.5
6	7.3	6.3	1.9	2.8	5.7	4.0
7	9.9	7.9	1.7	3.3	5.2	1.9
8	22.2	11.5	1.9	2.1	4.5	3.5
9	48.8	8.9	1.9	0.7	3.5	1.4
	100.0	100.0	100.0	100.0	100.0	100.0
Emotional resources						
Number of resources	Team	Other researchers	Non-researchers	Similar type	Different type	Family or friends
0	8.3	47.6	74.5	83.7	73.3	18.2
1	22.6	26.0	13.5	13.4	15.8	21.0
2	27.8	16.1	7.7	1.9	7.1	31.7
3	41.3	10.3	4.3	0.9	3.8	29.1
	100.0	100.0	100.0	100.0	100.0	100.0
Political resources						
Number of resources	Team	Other researchers	Non-researchers	Similar type	Different type	Family or friends
0	10.1	43.8	77.3	69.6	53.5	66.0
1	27.6	32.0	16.1	18.2	24.1	25.5
2	62.3	24.3	6.5	12.3	22.4	8.5
	100.0	100.0	100.0	100.0	100.0	100.0

Table 2.7 continued.

	Negative interactions					
Number of resources	Team	Other researchers	Non-researchers	Similar type	Different type	Family or friends
0	55.0	63.7	88.0	89.9	81.1	92.7
1	19.1	21.9	8.9	7.8	12.5	6.4
2	13.7	7.7	2.4	1.9	2.8	0.5
3	6.4	4.6	0.5	0.5	2.1	0.5
4	4.2	1.4	0.2	0.0	1.2	0.0
5	1.7	0.7	0.0	0.0	0.2	0.0
	100.0	100.0	100.0	100.0	100.0	100.0

Achievement goals

Achievement goals are measured with a validated psychometric scale (the work domain goal orientation instrument) developed by VandeWalle (1997). In particular, two achievement goals are measured: learning and performance goal orientation. The learning goal orientation is measured by five items and the performance goal orientation by four items from the goal orientation scale (see Table 2.8). A 5 point response scale, ranging from 1 ('disagree strongly') to 5 ('agree strongly'), is used for each item. Cronbach's alpha for learning is 0.85 and for performance is 0.75. The variables for each of the dimensions were constructed as the mean scores of the corresponding three items. The average value for a learning goal orientation is 4.24 (*SD* = 0.59) and for a performance goal orientation is 2.94 (*SD* = 0.77).

Table 2.8

Items of the achievement goal scale

Learning goal orientation
I am willing to select a challenging work assignment that I can learn a lot from.
I often look for opportunities to develop new skills and knowledge.
I enjoy challenging and difficult task at work where I'll learn new skills.
For me, development of my work ability is important enough to take risks.
I prefer to work in situations that require a high level of ability and talent.
Performance goal orientation
I'm concerned with showing that I can perform better than my coworkers.
I try to figure out what it takes to prove my ability to others at work.
I enjoy it when others at work are aware of how well I am doing.
I prefer to work on projects where I can prove my ability to others.

Team innovation climate

Team innovation climate is measured by the Team Climate Inventory, a scale developed by Anderson and West (1998) which consists of 38 items. Team innovation climate comprises five distinct dimensions: interaction frequency, participative safety, support for innovation, task orientation, and vision. Participative safety and support for innovation are measured by eight items each. Interaction frequency is measured with four items. For these three team dimensions, the response format ranges from 1 (strongly disagree) to 5 (strongly agree). Task orientation is measured using seven items with a response format ranging from 1 (very little extent) to 7 (a great extent). Finally, vision is measured with 11 items. The response format ranges from 1 (not at all) to 7 (completely). Table 2.9 gives a detailed overview of the items for each of the five dimensions of the team innovation climate and the reliability scores for each of the dimensions.

Table 2.9

Items of the team innovation climate scale

Interaction frequency ($\alpha = 0.91$)
We keep in touch with each other as a team.
We keep in regular contact with each other.
Members of the team meet frequently to talk both formally and informally.
We interact frequently.
Participative safety ($\alpha = 0.90$)
We share information generally in the team rather than keeping it to ourselves.
We have a 'we are in it together' attitude.
We all influence each other.
People keep each other informed about work-related issues in the team.
People feel understood and accepted by each other.
Everyone's view is listened to even if it is in a minority.
There are real attempts to share information throughout the team.
There is a lot of give and take.
Support for innovation ($\alpha = 0.91$)
This team is always moving toward the development of new answers.
Assistance in developing new ideas is readily available.
This team is open and responsive to change.
People in this team are always searching for fresh, new ways of looking at problems.
In this team we take the time needed to develop new ideas.

Table 2.9 continued.

People in the team cooperate in order to help develop and apply new ideas.
Members of the team provide and share resources to help in the application of new ideas.
Team members provide practical support for new ideas and their application.
Task orientation ($\alpha = 0.88$)
Do your team colleagues provide useful ideas and practical help to enable you to do the job to the best of your ability?
Do you and your colleagues monitor each other so as to maintain a higher standard of work?
Are team members prepared to question the basis of what the team is doing?
Does the team critically appraise potential weaknesses in what it is doing in order to achieve the best possible outcome?
Do members of the team build on each other's ideas in order to achieve the best possible outcome?
Is there a real concern among team members that the team should achieve the highest standards of performance?
Does the team have clear criteria which members try to meet in order to achieve excellence as a team?
Vision ($\alpha = 0.94$)
How clear are you about what your teams objective are?
To what extent do you think they are useful and appropriate objectives?
How far are you in agreement with these objectives?
To what extent do you think other team members agree with these objectives?
To what extent do you think your team's objectives are clearly understood by other members of the team?
To what extent do you think your team's objectives can actually be achieved?
How worthwhile do you think these objectives are to you?
How worthwhile do you think these objectives are to the organization?
How worthwhile do you think these objectives are to the wider society?
To what extent do you think these objectives are realistic and can be attained?
To what extent do you think members of your team are committed to these objectives?

For each team and for each dimension of the team innovation climate, the individual perceptions of researchers are aggregated to form team-level variables. Before aggregating, the interrater agreement (IRA) was calculated to examine whether there is a sufficient level of consensus

among the individuals to make reliable team-level constructs. The IRA is examined with two commonly used measures: the $r_{WG(J)}$ index and the absolute deviation (AD) index (LeBreton & Senter, 2008).

The $r_{WG(J)}$ index is developed by James, Demaree, and Wolf (1984, 1993) and measures the agreement in terms of the proportional reduction in error variance. For a single item, r_{WG} is calculated by

$$r_{WG} = 1 - \frac{S_X^2}{\sigma_E^2},$$

with S_X^2 as the observed variance on the variable X taken over K different raters and σ_E^2 as the variance expected when there is a complete lack of agreement among the raters (LeBreton & Senter, 2008). The expected variance when there is complete disagreement - in other words, the variance when all raters respond randomly when evaluating the target - is obtained from a theoretical null distribution. A vast majority of researchers choose a uniform null distribution – which implies that all response options have an equal chance of being selected. However, a certain positive leniency and social desirability is expected when team members rate climates on a Likert scale (Baer & Frese, 2003), making it necessary to consider a skewed distribution rather than a uniform distribution (LeBreton & Senter, 2008). In line with Baer and Frese (2003), we used the ratio of skewness to its standard error as an indicator of the strength of skewness. For each item, the values for σ_E^2 – which correspond to the level of skewness and the number of response categories of the item - are found in LeBreton and Frese (2008).

The single item index is expanded to J items which are essentially parallel items. The multi-item $r_{WG(J)}$ index, with the items j going from 1 to J, is calculated by

$$r_{WG(J)} = \frac{J\left(1 - \frac{\bar{S}_{X_j}^2}{\sigma_E^2}\right)}{J\left(1 - \frac{\bar{S}_{X_j}^2}{\sigma_E^2}\right) + \left(\frac{\bar{S}_{X_j}^2}{\sigma_E^2}\right)}$$

where $\bar{S}_{X_j}^2$ is the mean of the observed variances for J essentially parallel items and σ_E^2 is the variance expected when there is a complete lack of agreement among the raters (LeBreton & Senter, 2008).

Values of $r_{WG(J)}$ range between 0 and 1. However, out-of-range values (i.e. values less than 0 or greater than 1) are sometimes obtained. These values indicate a complete lack of agreement and

thus are set to zero. The general used cut-of-point for this index is .70 (LeBreton & Senter, 2008). Values below .70 are seen as an indication of insufficient agreement among the raters. In Table 2.10, the values for the $r_{WG(J)}$ index for each team and for each of the five dimensions of team innovation climate are presented (bold values indicate values lower than .70). On average for the teams, the items of support for innovation and task orientation were slightly skewed and the items of interaction frequency, participative safety, and vision were moderately skewed. The σ_E^2 values are thus calculated for each of the dimensions with the respective level of skewness.

Table 2.10

Interrater agreement indexes ($r_{WG(J)}$ and AD) for the five dimension of team innovation climate

	$r_{WG(J)}$					AD				
team	IF	PS	SI	TO	VI	IF	PS	SI	TO	VI
1	0.84	0.99	0.99	0.98	0.99	0.61	0.34	0.37	0.78	0.59
2	**0.19**	0.95	0.99	0.95	0.98	0.80	0.65	0.40	0.93	0.69
3	0.90	0.99	0.98	0.89	1.00	0.39	0.28	0.39	1.05	0.59
4	**0.00**	0.89	0.89	0.78	0.90	0.79	0.67	0.70	**1.21**	1.01
5	**0.58**	0.97	0.96	0.95	0.99	0.66	0.50	0.57	0.80	0.52
6	0.89	0.95	0.96	0.95	0.92	0.53	0.45	0.57	0.84	1.08
7	0.85	0.85	0.94	0.96	0.90	0.56	0.70	0.67	1.03	1.10
8	**0.00**	**0.15**	0.93	0.94	0.96	**0.87**	0.80	0.65	1.10	0.88
9	**0.67**	0.89	0.91	0.71	0.87	0.66	0.66	0.70	**1.38**	1.03
10	0.93	0.95	0.97	0.98	0.97	0.51	0.48	0.45	0.75	0.68
11	0.79	0.86	0.97	0.97	0.96	0.62	0.70	0.57	1.01	0.89
12	**0.67**	0.87	0.94	0.93	0.96	0.65	0.63	0.64	1.04	0.78
13	0.88	0.94	0.97	0.95	0.94	0.50	0.57	0.58	1.01	0.91
14	0.84	0.98	0.97	0.90	0.91	0.55	0.51	0.59	**1.23**	0.95
15	**0.68**	0.95	0.96	0.95	0.98	0.76	0.55	0.54	0.99	0.78
16	**0.28**	0.89	0.97	0.91	0.93	0.80	0.64	0.55	1.17	1.02
17	**0.00**	**0.27**	0.92	0.78	**0.61**	**0.97**	**0.84**	0.74	**1.30**	**1.23**
18	0.90	0.99	0.98	0.98	0.96	0.59	0.44	0.48	0.79	0.88
19	0.96	0.99	0.84	0.92	0.96	0.43	0.49	0.78	**1.33**	0.88
20	**0.00**	**0.32**	0.86	0.80	0.85	**0.98**	**0.84**	0.81	**1.27**	1.10
21	0.79	0.95	0.99	0.92	0.91	0.59	0.39	0.30	1.02	0.89
22	0.81	0.99	0.98	0.98	1.00	0.47	0.31	0.42	0.95	0.52

Table 2.10 continued.

	$r_{WG(J)}$					AD				
team	IF	PS	SI	TO	VI	IF	PS	SI	TO	VI
23	0.96	0.79	0.97	**0.00**	0.96	0.51	0.66	0.53	**1.72**	0.84
24	0.75	0.91	0.98	0.95	0.97	0.65	0.62	0.58	1.09	0.87
25	0.96	0.99	0.98	0.97	0.98	0.33	0.33	0.50	0.86	0.63
26	**0.00**	0.84	0.92	0.95	**0.57**	0.80	0.69	0.72	0.97	**1.30**
27	0.83	0.97	0.95	0.98	0.94	0.52	0.61	0.60	0.96	0.87
28	0.87	0.85	0.97	0.92	0.97	0.51	0.68	0.48	1.07	0.84
29	0.91	0.88	0.95	0.92	0.97	0.42	0.63	0.57	1.16	0.72
30	0.85	0.97	0.99	1.00	0.97	0.49	0.31	0.35	0.76	0.91
31	0.77	0.90	0.98	0.97	0.91	0.67	0.64	0.56	0.99	0.95
32	0.82	0.89	0.98	0.95	0.86	0.62	0.56	0.50	1.05	1.06
33	0.89	0.97	0.99	0.96	0.98	0.49	0.44	0.39	0.93	0.72
34	0.92	0.97	0.99	0.98	0.97	0.46	0.47	0.39	0.80	0.89
35	0.81	0.92	0.97	0.80	0.97	0.54	0.57	0.50	**1.33**	0.79
36	0.88	0.94	0.96	0.95	0.96	0.45	0.58	0.61	1.10	0.89
37	0.86	0.93	0.97	0.90	0.96	0.45	0.53	0.50	1.12	0.75

Note. IF = interaction frequency, PS = participative safety, SI = support for innovation , TO = task orientation, VI = vision.

In addition to the $r_{WG(J)}$ index, the interrater agreement was examined by the absolute deviation (AD) index. The AD-index is developed by Burke, Finkelstein, and Dusig (1999) and is for a single item calculated by

$$AD_{M(j)} = \frac{\sum_{k=1}^{K}|X_{jk}-\bar{X}_j|}{K},$$

where k=1 to K raters, X_{jk} is the kth rater's rating on the jth item, and X_j is the item mean taken over raters. For *J* items rated by K rater, the AD index is calculated by

$$AD_{M(J)} = \frac{\sum_{j=1}^{J} AD_{M(J)}}{J},$$

where all terms are as defined above and j=1 to J items.

Values of the AD-index higher than c/6 (c = number of answering categories per item) are an indication of insufficient agreement among the team members. Interaction frequency,

participative safety, and support for innovation have a response format with five categories, resulting in a maximum value of 0.83 that should not be exceeded. Task orientation and vision have a response format with seven categories. resulting in a maximum value of 1.17 that should not be exceeded (LeBreton & Senter, 2008; Levecque, Roose, Vanroelen, & Van Rossem, 2014). AD values for each team are presented in Table 2.10. The AD-values that exceed their corresponding threshold are printed bold.

In general, two teams were found which had a considerable number of values for both indexes which did show insufficient agreement. Team 17 has three $r_{WG(J)}$ values below .70 and three AD-values that exceeded the threshold. Team 20 has two values for the $r_{WG(J)}$ index and three values for the AD-index that indicated insufficient agreement.

Innovative work behavior

For the researchers' innovative work behavior, we relied on the validated, multi-dimensional scale of Janssen (2000). Innovative work behavior comprises three distinct dimensions: idea generation, idea promotion and idea implementation. The scale consists of nine items, three for each of the dimensions (see Table 2.11). The response format ranges from 1 ('never') to 7 ('always'). Cronbach's alpha is 0.92 for idea generation, 0.90 for idea promotion, and 0.87 for idea implementation. The variables for each of the dimensions was constructed as the mean scores of the corresponding three items. The respondents had a mean value of 4.99 (*SD* = 1.32) for idea generation, of 4.80 (*SD* = 1.50) for idea promotion, and of 4.53 (*SD* = 1.58) for idea implementation.

Table 2.11

Items of the innovative work behavior scale

Idea generation
Creating ideas for difficult issues.
Searching out new working methods, techniques, or instruments.
Generating original solutions for problems.
Idea promotion
Mobilizing support for innovative ideas.
Acquiring approval for innovative ideas.
Marking important organizational members enthusiastic for innovative ideas.
Idea implementation
Transforming innovative ideas into useful applications.
Introducing innovative ideas into the work environment in a systematic way.
Evaluating the utility of innovative ideas.

3. THE SOCIAL CONSEQUENCES OF ACHIEVEMENT GOALS WITHIN WORK TEAMS.

The implications of achievement goals with regard to workplace social relationships have been mainly examined through experimental studies. This current study argues that the influence of an individual's achievement goals on his or her social relationships is context specific. Therefore, the association between achievement goals and social relationships is examined in real-world, work team settings. Network analysis techniques are used to study the effects of achievement goals on cooperation, trust, and distrust relationships. The analyses of the degree and constraint of the networks of 428 researchers within 37 research teams provide results that contradict those from former experimental studies. More specifically, a strong learning goal orientation by individuals induces less trust and more distrust from other team members, even though these individuals trust their team members more. The expected antisocial behavior associated with a performance goal orientation is not confirmed. These findings give a more accurate insight into how achievement goals influence the social behavior of individuals, as the social constraints that influence social behavior are taken into account.

Within research teams, individuals have to collaborate on many tasks (Cohen, Kruse, & Anbar, 1982; Lee & Bozeman, 2005). Social relationships are unavoidable, but also beneficial. Individual researchers depend on their colleagues in order to carry out tasks, and they experience performance benefits by working together, sharing knowledge and skills, asking for advice, etc. Furthermore, teamwork is not only beneficial for individual performance, but also for team performance. Individual researchers' behavior is not only driven by the demands of meeting their individual and team standards, but also by their individual goal orientations. These individual goal orientations provide extra motivation and partly explain why individuals engage in certain activities and what they hope to gain from them. Recent studies, mainly with an experimental design (notable exception Janssen & Van Yperen, 2004), have examined how a person's achievement goals influence whether they want to engage in social relationships and influence their perception of others (for a review see Poortvliet & Darnon, 2010). These experimental studies have examined isolated dyadic relationships, but have not taken into account the social context of a team, which constrains the behavior of members. This study argues that individual-level antecedents of social interactions, such as goal orientation, are context specific. Therefore, we focus on the association between achievement goals and social relationships in real-world team settings rather than in an experimental setting and examine whether the expected relational outcomes are present in a team context. An investigation of social relationships and network structures is indispensable, as informal work relationships are an essential part of organizational life (Agneessens & Wittek, 2008; Casciaro & Lobo, 2008; Völker & Flap, 2004).

Previous research has examined the relational implications of two achievement goals for social relationships in the workplace: 1) a learning goal orientation – that is, to develop abilities and acquire new skills – and 2) a performance goal orientation – that is, to demonstrate abilities and gain positive evaluations or favorable judgments (Poortvliet & Darnon, 2010; VandeWalle, 1997). Achievement goals are argued to influence two network characteristics: degree and constraint, two standard summary measures of the immediate network environment of individuals (Kalish & Robins, 2006). First, as achievement goals influence the preference and intention to interact with others, achievement goals will affect the number of relationships with other team members: the degree. Second, achievement goals are also expected to be related to the network constraints a person experiences. These constraints stem from connections with other team members who are themselves highly interconnected. Degree and constraint capture the access to resources (such as advice and support) and the ability to make use of these resources (Burt, 2010).

An individual's achievement goal orientation not only influences their propensity to form contacts within their own subgroup, as opposed to contacts with more remote coworkers, but also determines the nature of the relationships they have with their team members. Work teams, as social systems, encompass a multitude of overlapping social relations, which all influence performance (Henttonen, 2010). An examination of relationships among work team members indicates that instrumental relations are most prominently present. This is reflected in the large number of instrumental relations, such as giving and receiving advice, knowledge sharing, problem solving, consultation, and technical-related communication, all of which have been studied in past work team research (Henttonen, 2010). However, researchers do not only connect through instrumental relations, but also through affective relations. Affective relations can be positive (such as socializing, friendly relations, or friendship) or negative (such as dislike or hindrance) (Henttonen, 2010). Although these relationships overlap, they all have distinct contents and dynamics. For example, affective relations differ from instrumental relations in that the former take more time to emerge and form (Kratzer, Leenders, & Van Engelen, 2005). Due to their distinct nature, it is therefore relevant to examine the influence of achievement goals on each of the three types of relations. Specifically, cooperation will be examined as instrumental, trust as positive affective, and distrust as negative affective.

3.1 Achievement Goals and Degree

Degree, as size of individuals' direct networks, can be defined in two ways. On the one hand, the number of relations that an individual sends out to other individuals can be considered (i.e. outdegree measure). For example, the outdegree of the trust network for an individual comprises all the relations that the individual defines as trustful. On the other hand, the number of relations that an individual receives from others can be considered (i.e. indegree measure). The indegree of the trust network for an individual consists of all relations of that individual that the others define a trustful. Both perceptions on degree are considered in this section.

As mentioned in the introduction, a certain level of functional interdependence can be expected among members of research teams. Unrelated to that, individuals also experience dependence upon others in that they need to maintain a relationship with others in order to attaining their goals (Poortvliet & Darnon, 2010). Hence, the inclination of a person towards engaging in relationships with other team members is dependent on that person's goal orientations. Individuals oriented toward a learning goal aim at improving their abilities. In this case, goal attainment is judged by comparing present abilities with previous abilities. Accordingly, individuals with a learning goal orientation have a self-referenced focus and are not dependent on

others to reach their learning goal, as there is no outcome interdependence (Poortvliet, Anseel, Janssen, Van Yperen, & Van de Vliert, 2012; Poortvliet & Darnon, 2010; Poortvliet, Janssen, Van Yperen, & Van de Vliert, 2007, 2009). Furthermore, a learning goal leads to positive means interdependence. Skills and abilities can be improved by the work-related knowledge, information, and experience of coworkers. In other words, coworkers are considered helpful in the attainment of a learning goal (Darnon, Butera, & Harackiewicz, 2007; Janssen & Van Yperen, 2004; Poortvliet et al., 2012; Poortvliet & Darnon, 2010; Poortvliet et al., 2007, 2009). Past research has shown that a learning goal orientation does indeed lead to more pro-social behavior. For example, individuals with a learning orientation tend to establish high-quality exchange relationships with their supervisors (Janssen & Van Yperen, 2004), engage in task-related cooperation (Poortvliet et al., 2009), are honest when sharing information, endorse reciprocity (Poortvliet et al., 2007), and help others (Poortvliet & Darnon, 2010).

To individuals with a learning goal orientation, cooperation relationships tend to be low cost as there is no outcome interdependence, while in line with their positive means interdependence they expect high benefits from their relationships, as these can provide beneficial instrumental resources. Therefore, it could be expected that individuals oriented toward a learning goal establish a large number of cooperation relationships. Because individuals with a learning goal orientation experience others as helpful with regard to attaining their goals, and because they have been found to engage in high-quality exchange relations with supervisors, individuals with this orientation are expected to establish a large number of trust relations. As a learning goal does not induce any outcome interdependence in the attainment of the learning goal, there are no competitive feelings that bring forward distrust relations. In addition, as former research has also found that a learning goal orientation leads to more pro-social behavior, distrust relations are not expected to be induced by a learning goal orientation.

Based on the behaviors (e.g. pro-social, non-competitive) set by individuals with a learning goal orientation, which are expected to result in trustful and cooperative attitudes, there are no indications that individuals with a learning goals will be perceived as distrustful. Therefore, it is expected that others will reciprocate the trust and cooperation relations towards individuals with a learning goal and do not have distrustful relations with these individuals. This expectation is in line with the reciprocity theory in social psychology (Falk & Fischbacher, 2006). Hence, we hypothesize that, in the perceptions of the individual (outdegree), as well as by the others (indegree), a learning goal relates positively to the number of cooperation and trust relations and negatively to the number of distrust relations.

Hypothesis 1(a-c): A learning goal orientation relates (a) positively to the degree of cooperation relations, (b) positively to the degree of trust relations, and (c) negatively to the degree of distrust relations.

Individuals with a performance goal orientation, to the contrary, want to show their abilities and to compete with and outperform others. Coworkers form the reference group to which the individual with a performance goal compares his performance. Therefore, individuals with a performance goals are dependent upon other for the attainment of their performance goal (i.e. outcome interdependence) (Poortvliet et al., 2012; Poortvliet & Darnon, 2010; Poortvliet et al., 2007, 2009). Even though external social resources, such as knowledge held by coworkers, are believed to be valuable, a performance goal orientation leads to a more reluctant stance toward social interaction for two reasons. First, social interactions hold the risk of appearing incompetent (Swift, Balkin, & Matusik, 2010), which contradicts the intended goal of outperforming others. Second, social relations are founded on the obligation to reciprocate. This therefore implies that in order for a person to receive resources, their own resources must be given in exchange. In that way, the exchange partner can also benefit from the resources, thereby improving their ability. Again, this conflicts with the intended goal. Poortvliet et al. (2007) concluded that a performance goal orientation results in weak reciprocity and a strong exploitation orientation. Therefore, in a context where individuals cannot avoid the reciprocal exchange of resources, individuals with a performance goal orientation experience a negative means interdependence with coworkers (Darnon et al., 2007; Janssen & Van Yperen, 2004; Poortvliet et al., 2012; Poortvliet & Darnon, 2010; Poortvliet et al., 2007, 2009). In this way, coworkers are seen as a threat to the attainment of a person's own performance goal (Janssen & Van Yperen, 2004; Poortvliet & Darnon, 2010; Poortvliet et al., 2007). Furthermore, a performance goal orientation can result in a degree of maladaptive or antisocial behavior, as it induces behavior toward the exploitation of coworkers and a reluctance to share knowledge resources with colleagues (Poortvliet et al., 2012; Poortvliet et al., 2007). Previous studies have found performance goals to be related to disruptive and thwarting behaviors (Poortvliet & Darnon, 2010) and in a reluctance to cooperate with others (Poortvliet et al., 2009). Emotionally, individuals with a performance goal orientation keep more distance and tend not to build high-quality exchange relations with supervisors (Janssen & Van Yperen, 2004).

Individuals with a performance goal orientation experience higher costs from engaging in social relationships, as they may be obliged to reciprocate and also risk losing credibility if they appear

incompetent. Due to the outcome and negative means interdependence, individuals with a strong performance goal orientation are expected to have fewer cooperation relationships than individuals with a weak performance goal orientation. As individuals with a strong performance goal orientation are emotionally distant, they are expected to have fewer trust relations, and because they see others as threats to the attainment of their goal, they are expected to have more distrust relations.

The high distrust and low trust in and cooperation with others in the network of individuals with a performance goal is expected to result in similarly defined relations by the others. In other words, others will see individuals with a performance goal also as distrustful. The number of relations defined by others as trustful and cooperative is expected to be low. Hence, we expect that, in the perceptions of the individual (outdegree), as well as by the others (indegree), individuals with a strong performance goal orientation have fewer cooperation and trust relations and more distrust relations than individuals with a weak performance goal orientation.

> *Hypothesis 2(a-c)*: A performance goal orientation relates (a) negatively to the degree of cooperation relations, (b) negatively to the degree of trust relations, and (c) positively to the degree of distrust relations.

3.2 Achievement Goals and Network Constraint

In the previous section, we discussed the way in which achievement goals relate to the number of contacts a person has within a team. Next, we turn our attention to the level of network constraint. Being embedded within a highly interconnected (sub)group restricts the behavior of individuals. In this situation, individuals have less or no opportunities to start new connections that offer exposure to contacts who differ in opinion or the way they behave, and a similar lack of opportunities to broker among individuals who are not directly connected (Burt, 2010). As network constraint is only relevant for networks that have a considerable number of relations and only has meaning for cooperation and trust relations, this feature is not examined for distrust networks.

Individuals with a learning goal orientation believe that ability can be developed through effort and experience. For them, effort leads to success and when encountering challenging tasks they will persist in their efforts until they succeed. Therefore, effort is necessary to attain their desired goal of personal development (VandeWalle & Cummings, 1997). In addition, individuals oriented toward a learning goal prefer more challenging and complex work. They enjoy the challenge of innovative tasks, and respond proactively if unexpected obstacles occur. These individuals tend

to be relatively independent and open to change (Janssen & Van Yperen, 2004). Proactive, independent individuals who perform well in situations of change and find pleasure in convincing others, have been found to have networks with lower constraint (Burt, Jannotta, & Mahoney, 1998). Hence, individuals with a learning goal orientation are expected to have networks with low constraint.

> *Hypothesis 3(a-b)*: A learning goal orientation relates (a) negatively to the network constraint of cooperation relations, and (b) negatively to the network constraint of trust relations.

Individuals with a performance goal orientation hold the belief that intellectual ability and skills are somewhat fixed and less easily influenced compared with individuals with a learning goal orientation. Effort is not seen as a means for developing ability by individuals with a performance goal orientation and high effort is perceived as an indicator of low ability. Unwilling to show their inabilities, they will be reluctant to exert great effort. Difficult and demanding tasks are therefore avoided, as continued effort to accomplish the task and possibly failing to succeed create the risk of revealing low ability (Dweck, 2000; Janssen & Van Yperen, 2004; VandeWalle, 1997; VandeWalle & Cummings, 1997). Thus, a strong performance goal orientation makes individuals prefer safe and rehearsed task strategies and task components. They prefer to be trained to carry out work in such a way that tasks become automated and quickly executed (Janssen & Van Yperen, 2004). Individuals with a performance goal orientation can be seen as less entrepreneurial, because they do not look for opportunities to find new ways to carry out tasks or take up new challenges. Burt, Jannotta, and Mahoney (1998) found that individuals who prefer security and stability have more constraining networks. Therefore, individuals with a strong performance goal orientation are expected to have networks with high constraint.

> *Hypothesis 4(a-b)*: A performance goal orientation relates (a) positively to the network constraint of cooperation relations, and (b) positively to the network constraint of trust relations.

3.3 Method

Research Setting and Sample

Data was collected between March 2011 and July 2012 as part of a research project on the antecedents and outcomes of social relationships within research teams. The respondents were all members of research and/or development teams within industry or universities in Flanders. All the industrial teams were embedded in research-intensive industries: IT or technology,

pharmaceuticals, chemistry, and biotechnology. The university teams came from the equivalent academic disciplines. Team leaders were contacted and asked whether they and their team would be willing to participate in the study. During a personal meeting, the team leaders were informed in detail about the content and practical aspects of the study. The data was gathered by means of a questionnaire. Team leaders completed their questionnaire during the personal meeting, while for the team members, paper questionnaires were given to the leaders for further distribution. After completion, the team members returned the questionnaires in sealed envelopes for reasons of confidentiality. Because network data was involved, the questionnaires could not be anonymous. Nonetheless, the response rate was high. In total, 520 questionnaires were distributed among the members of 37 teams, of which 428 were returned completed. Therefore, the overall response rate was 81.8%. The participants comprised nine industrial teams, with a total of 75 members, and 28 academic teams, with 353 members.

Social Network Data

Social networks. For each team, an instrumental, positive, and negative affective network was constructed, based on the data provided by the members. Cooperation was chosen as the instrumental relationship, as this has been frequently studied by academic researchers (Crane, 1969; Griffith & Mullins, 1972; Price & Beaver, 1966). As the positive affective relationship, trust was chosen, with the negative counterpart of distrust as the negative affective relationship. Even though trust has been found to consist of both affective and cognitive aspects (Casciaro & Lobo, 2008; Lewis & Weigert, 1985; Mayer, Davis, & Schoorman, 1995), trust, has been examined as one of the key affective constructs in network studies (Casciaro & Lobo, 2008).

The data was collected through a sociometric procedure. Two rosters with the names of all team members were provided to each of the respondents. In the first roster the respondents had to indicate which team members they cooperated with. For each team, this results in a cooperation network in which all the relationships that are indicated as cooperative are given the value 1 and all other relationships have the value 0. In the second roster the respondents were asked to indicate on a scale from 1 (completely distrust) to 7 (completely trust) how much they distrusted or trusted the other members of their team. In the middle of the scale (number 4), the category 'neither trust nor distrust' was provided. Both the trust and distrust networks are derived from this roster. All the relationships that were given a value 6 or 7 on the scale are identified as trust relations. Relationships with a value of 5 ('rather trust') were not included as trust relations, as individuals have been found to respond to some extent in a socially desirable manner on items of interpersonal trust (Rotter, 1967). In this way, neutral trust relations would also be described as

'rather trust'. All relationships that have a value of 1, 2, or 3 on the scale are identified as distrust relations. Both trust and distrust networks are coded as digraphs. Thus, trust and distrust are conceptualized as two distinct constructs that oppose each other (McKnight & Chervany, 2001; Schoorman, Mayer, & Davis, 2007). The trust and distrust networks of the teams have an average correlation of -.23 (minimum correlation: -.04; maximum correlation: -.53).

Dependent Variables

Degree. The degree of a person's network can be measured as the number of relations initiated by either the ego (outdegree) or the alters (indegree). An indegree measurement can be seen as the most reliable, as it is based on the observations of multiple respondents instead of only one. The outdegree measurement is more commonly used in studies of the outcomes of goal orientation. Thus, for reliability reasons, an indegree measurement is preferable, but for comparisons with existing research, an outdegree measurement is more appropriate. As both have their merits, we include both the ego and alters perceptions of degree in this study. Because it is expected that they do not relate differently to achievement goals, no separate hypothesis are formulated for the ego and alter aspects of the network measurements.

Network constraint. For assessing network constraint, we use Burt's (2010) constraint measurement. This examines how the relationships of an individual are concentrated in a single subgroup. When all the relationships of a person are with individuals who are also all interconnected, the constraint is high. In a case when the alters are not connected, the constraint is low. Network constraint is calculated using the following formula:

$$C_i = \sum_{\substack{j=1 \\ j \neq i}}^{n} c_{ij}$$

with

$$c_{ij} = \left(p_{ij} + \sum_{\substack{k=1 \\ i \neq j \neq k}}^{n} p_{ik} p_{kj} \right)^2$$

and

$$p_{ij} = X_{ij} / d_i$$

With regard to an individual *i*, p_{ij} is the proportional weight the tie to *j* has for *i*. In practice, p_{ij} is computed by the value X_{ij} (0 or 1) of the tie from *i* to *j* divided by the degree of *i*. In similar way, p_{ik} is the proportional weight of the tie from *i* to *k*, and p_{kj} the proportional weight of the tie from *k* to *j*.

Independent Variables

Achievement goals. Two achievement goals are examined in this study: learning goal orientation and performance goal orientation. The initial dichotomy between a learning and a performance goal orientation has been extended in recent years, by dividing both the achievement goals into approach and avoidance forms. The approach form of the achievement goal means striving to experience positive outcomes (e.g. to learn more or to outperform others) and the avoidance form means striving not to experience negative outcomes (e.g. to avoid the deterioration of knowledge or avoid appearing incompetent). As the discussion on the relational implications of achievement goals focuses on the approach forms, rather than on the avoidance forms (Darnon et al., 2007; Poortvliet et al., 2009), this study will also focus on the approach forms of the achievement goals. For measuring achievement goals within a work context, we rely on the 'work domain goal orientation instrument' of VandeWalle (1997). The learning (approach) goal orientation is measured by five items from this goal orientation scale, for example "I often look for opportunities to develop new skills and knowledge" and "I enjoy challenging and difficult tasks at work where I will learn new skills". The performance (approach) goal orientation is measured by four items, for example "I prefer to work on projects where I can prove my ability to others" and "I enjoy it when others at work are aware of how well I am doing". A five-point response scale, ranging from 1 (completely disagree) to 5 (completely agree), is used for each item. Cronbach's alpha for learning is 0.85 and for performance is 0.75.

Control Variables

At the individual level, gender, level of education, and tenure within the team were added as control variables. The size of the team and the type of the team (academic or industrial) were added as team-level control variables. As network constraint varies with the size of the network – i.e. in larger networks the network constraint is lower (Burt, 2010) – outdegree is added as an additional control variable when considering constraint.

Analytic Approach

This study examines how achievement goals, controlled for socio-demographic characteristics, relate to eight separate network measurements: ego and alters results for the degree of cooperation, trust, and distrust, together with constraint in the cooperation and trust networks. Therefore, separate analyses were run for each of the eight network measurements. As the data is hierarchically nested (a researcher is nested within a research team) two-level hierarchical models were run. Given the nature of the dependent variables, a multilevel negative binomial analysis with the team size (minus one) as the offset variable is most appropriate for the degree variables. The network constraint variables follow a normal distribution, making a linear multilevel regression analysis possible.

3.4 Results

Descriptive statistics and bivariate intercorrelations are shown in Table 3.1. A small but significant positive correlation ($r = .26$) is found between the learning and performance goal, which is in line with reported values in other research (Janssen & Van Yperen, 2004; VandeWalle & Cummings, 1997). Since both a learning and performance goal in this study are approach-oriented, the correlation is expected to reflect the approach-oriented achievement motivation present in both orientations (Janssen & Van Yperen, 2004). Nonetheless, the correlation can be an indication that learning and performance goals are less orthogonal than expected in the existing theory. Table 3.2 summarizes the results of the negative binomial models with the degree measurements of cooperation, trust, and distrust networks as dependent variables.

Table 3.1

Means, standard deviations, and correlations among study variables

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
1.Learning goal																	
2.Performance goal	0.26***																
3.Cooperation – Network outdegree	0.13**	0.05															
4.Cooperation – Network indegree	0.12*	0.11*	0.49***														
5.Trust – Network outdegree	0.10*	-0.06	0.19***	0.08													
6.Trust – Network indegree	-0.05	-0.06	0.29***	0.43***	0.31***												
7.Distrust – Network outdegree	-0.05	0.05	0.13**	0.20***	0.02	0.30***											
8.Distrust – Network indegree	0.16**	0.07	-0.01	-0.03	0.08	-0.15***	0.07										
9.Cooperation – network constraint	-0.16**	-0.10*	-0.60***	-0.66***	-0.29***	-0.43***	-0.20***	-0.03									
10.Trust - network constraint	-0.07	-0.01	-0.23***	-0.24***	-0.58***	-0.63***	-0.25***	-0.07	0.53***								
11.Gender[a]	0.13**	0.07	0.13**	0.09	-0.03	-0.11*	-0.05	-0.04	-0.07	0.12*							
12.Academic master's[b]	-0.19***	-0.09	-0.32***	-0.39***	-0.01	-0.06	0.07	-0.02	0.30***	-0.04	-0.10*						
13.Doctorate[b]	0.26***	0.07	0.29***	0.32***	0.04	0.09	-0.01	0.06	-0.25***	0.00	0.12*	-0.75***					
14.Tenure in team	0.03	0.08	0.38***	0.41***	0.00	0.14**	0.09	0.01	-0.27***	-0.01	0.16**	-0.40***	0.28***				
15.Type of team[c]	0.10*	0.10*	0.05	0.14**	-0.25***	-0.27***	-0.12*	-0.11*	-0.03	0.32***	0.14**	-0.22***	0.02	0.17**			
16.Alters	0.03	-0.01	0.16**	0.14**	0.51***	0.57***	0.32***	0.28***	-0.39***	-0.76***	-0.14**	0.09	-0.04	-0.07	-0.39***		
17.Team size	0.03	-0.01	0.16**	0.14**	0.51***	0.57***	0.32***	0.28***	-0.39***	-0.76***	-0.14**	0.09	-0.04	-0.07	-0.39***	1.00***	
Mean	4.24	2.94	5.17	4.24	8.94	7.31	0.76	0.62	0.49	0.34	0.63	0.49	0.37	5.25	0.17	17.80	18.80
Standard deviation	0.59	0.77	4.77	2.54	6.33	3.83	1.47	1.23	0.21	0.17	0.48	0.50	0.48	6.26	0.37	9.31	9.31

Note. n ranged from 404 to 520.

[a] 0= female; 1=male; [b] Reference category: professional master or lower; [c] 0= academic; 1=industry; *p<.05 **p<.01 ***p<.001

Table 3.2

Multilevel negative binomial models for network degree variables related to the cooperation, trust, and distrust network (N = 404) (standard errors in parentheses)

	Cooperation		Trust		Distrust	
	Network outdegree	Network indegree	Network outdegree	Network indegree	Network outdegree	Network indegree
Intercept	-1.77***	-1.59***	-0.93***	-0.45**	-3.39***	-6.75***
	(0.34)	(0.22)	(0.23)	(0.17)	(0.67)	(0.92)
Gender[a]	0.20*	0.02	0.09	0.00	-0.14	-0.19
	(0.09)	(0.06)	(0.06)	(0.04)	(0.17)	(0.22)
Academic	-0.24	-0.15	0.03	0.05	0.65*	0.10
Master's[b]	(0.14)	(0.09)	(0.09)	(0.07)	(0.30)	(0.36)
Doctorate[b]	0.22	0.21**	0.08	0.14*	0.26	0.20
	(0.13)	(0.08)	(0.09)	(0.07)	(0.30)	(0.35)
Tenure in team	0.03***	0.02***	0.00	0.01***	0.05***	0.01
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.02)
Learning goal	0.09	0.02	0.11*	-0.07*	-0.22	0.66**
	(0.07)	(0.05)	(0.05)	(0.04)	(0.15)	(0.21)
Performance	-0.02	0.04	-0.05	-0.02	0.19	0.12
goal	(0.05)	(0.03)	(0.04)	(0.03)	(0.11)	(0.14)
Type of team[c]	0.54***	0.64***	0.02	0.09	-0.04	0.01
	(0.16)	(0.17)	(0.11)	(0.13)	(0.30)	(0.34)

Note. Offset for all models is the maximum possible number of team contacts.

[a] Reference category: female

[b] Reference category: professional master's or lower

[c] Reference category: academic teams

*p<.05 **p<.01 ***p<.001

Hypothesis 1a predicted that a learning goal would have a positive effect on the degree of the cooperation relations. In Table 3.2, neither the ego nor alter measurements for the degree of cooperation are affected by a learning goal orientation. Therefore, Hypothesis 1a is not supported. Hypothesis 1b suggested that a learning goal would have a positive effect on trust relations. A significant positive effect is found from a learning goal orientation and the outdegree of the trust network. In contrast, a learning goal has a negative effect on the indegree of the trust

network. Thus, Hypothesis 1b is supported with regard to the outdegree measurement, but not the indegree one. Hypothesis 1c proposed that a learning goal would negatively affect the degree of distrust relations. The results show that a learning goal does not relate to the outdegree of the distrust network, but positively affects the indegree of the distrust network. Hence, Hypothesis 1c is not supported. The results show that although individuals with a strong learning goal orientation see themselves as having more trust relations, they are trusted less by their alters and are also more distrusted by them.

Hypothesis 2a claimed that a performance goal would negatively affect the degree of cooperation relations. In Table 3.2, both the indegree and outdegree measurements for the cooperation network are found to be independent of an individual's performance goal orientation. Hypothesis 2a is thus not supported. Hypothesis 2b stated that a performance goal would negatively affect the degree of trust relations. A performance goal orientation is not found to have a significant effect on either the indegree or outdegree measurements for the trust network. Thus, Hypothesis 2b is also not supported. Hypothesis 2c proposed a positive effect of a performance goal orientation on the degree of distrust relations. The results do not support this hypothesis either. In short, a performance goal orientation is not found to have any effect on the degree measurements. These findings contradict existing research on the antisocial behavior induced by performance goals (Poortvliet et al., 2012; Poortvliet & Darnon, 2010; Poortvliet et al., 2007).

In Table 3.3, the models for the network constraint measurements for cooperation and trust are shown. Hypothesis 3a stated that a learning goal orientation would negatively affect the constraint in the cooperation network. In Table 3.3, a negative and significant effect is found from a learning goal orientation on the constraint in the cooperation network. Thus, Hypothesis 3a is supported. Hypothesis 3b proposed a negative effect from a learning goal on the constraint in the trust network. However, no significant relation is found between a learning goal orientation and the network constraint for trust. Hypothesis 3b is therefore not supported. Thus, individuals with a strong learning goal orientation take up less constraining network positions in the cooperation networks.

Table 3.3

Multilevel regressions for network constraint variables of the cooperation and trust networks (N = 404) (standard errors in parentheses)

	Network constraint cooperation	Network constraint trust
Intercept	0.96***	0.73***
	(0.06)	(0.05)
Gender[a]	-0.02	0.00
	(0.01)	(0.00)
Academic master's[b]	0.02	0.00
	(0.02)	(0.01)
Doctorate[b]	-0.03	-0.00
	(0.02)	(0.01)
Tenure in team	-0.00*	-0.00*
	(0.00)	(0.00)
Learning goal	-0.02*	-0.00
	(0.01)	(0.00)
Performance goal	-0.01	-0.00
	(0.01)	(0.00)
Outdegree cooperation	-0.02***	
	(0.00)	
Outdegree trust		-0.00***
		(0.00)
Team size	-0.01***	-0.02***
	(0.00)	(0.00)
Type of team[c]	-0.07	-0.02
	(0.05)	(0.05)

[a] Reference category: female

[b] Reference category: professional master's or lower

[c] Reference category: academic teams

*p<.05 **p<.01 ***p<.001

Hypothesis 4a claimed that a performance goal orientation would positively affect the constraint in the cooperation network. In Table 3.3, no significant effect is found from a performance goal on the constraint in the cooperation network. Thus, Hypothesis 4a is not supported. Hypothesis 4b proposed a positive effect between a performance goal and constraint in the trust network. Again, a performance goal orientation is found to have no effect on the trust network constraint. Hypothesis 3b is hence not supported. Thus, a performance goal is not found to relate to either of the network constraint measurements.

Tenure within the team is found to be an important individual-level control variable. The amount of time spent within a team creates more cooperation, increased trust and distrust relations, and lowers the constraint within the cooperation and trust networks. Furthermore, based on the alter measurements, doctorate holders are found to have larger cooperation and trust networks. Gender plays only a minor role for social interactions. At the team level, the number of cooperation relations is found to be higher for a researcher within an industrial team than in an academic team.

3.5 Discussion

This study examines how achievement goal orientations influence the degree and constraint of individuals' networks. The results of this study provide several points for discussion. First, the findings indicate that for individuals with a learning goal orientation, there is a discrepancy between the measurements for trust and distrust relations with regard to ego and alters. A learning goal orientation leads to a larger trust network when considering the ego measurements, but to a smaller trust network and a larger distrust network when considering the alter measurements. This shows that individuals oriented toward a learning goal see themselves as having trustful relations with others, while others are less likely to trust them and more likely to distrust them. The latter results contradict expectations based on existing insights into the behavioral outcomes of achievement goals. Thus, the proactive and independent nature of these individuals, which makes them have less constraining networks, also diminishes their trustworthiness. In their study on personality as an antecedent for the indegree centrality of adversarial team networks, Klein, Lim, Saltz, and Mayer (2004) found similar counterintuitive results for extravert and open individuals within teams. Team members regard individuals who exhibit high extraversion or openness, as individuals who have difficult relationships within the team. Thus, similar to the way extravert and open individuals are seen as a source of annoyance, individuals with a learning goal orientation are seen as less trustworthy.

Second, being oriented toward a performance goal has no effect on either degree or constraint. These results contradict existing literature, which ascribes negative behaviors and outcomes to pursuing performance goals. However, the majority of research that supports performance goal orientation resulting in maladaptive social behavior has been carried out in experimental settings (notable exceptions Janssen & Van Yperen, 2004; VandeWalle & Cummings, 1997). Within these experimental settings, the behavior of participants is not subject to social constraint. When embedded in a social system such as a team, social behavior – and especially antisocial behavior – will be constrained. These constraints stem from norms and values in the team, as well as from the social control within the team. In most teams, antisocial behavior, such as the exploitation of coworkers or not reciprocating within exchange relations, are not accepted and will be sanctioned. It can therefore be expected that the maladaptive behavior induced by a performance goal is likely to be minimized, masked, and/or altered. A possible explanation for the non-significant effects of a performance goal on the degree of cooperation and on trust networks is that we examined them within team networks. Klein et al. (2004) argued that in small, dense, and ongoing social networks such as research teams, even individuals who are less inclined to interact with others (introverted individuals in their study) do form and maintain relationships within the team. Perhaps it is only in more sparse and large networks, with less task dependency, that individuals will have enough freedom to act as they are inclined to by their goal orientation and other personal dispositions.

These findings show that studying the relationship between achievement goals and network structures should not be limited to isolated dyadic relationships, but instead should be broadened to investigate both the dyadic and structural features embedded in a larger social structure (e.g., a team, a department, or an organization). Social structures constrain and influence the behavior of their members (Friedkin & Johnsen, 2011; Granovetter, 1985). Individuals create perceptions of one another based not only on their individual behavior, but also on the interpersonal behavior with others in the structure. Therefore, interpersonal behavior does not only affect the future behavior between the two people involved, but also the future behavior of those two individuals with the other people within the structure.

Furthermore, the discrepancy between the ego and alter measurements for degree indicates the necessity for caution when measuring social relationships. The self-reporting of social relations, especially affective relations, has been proven to differ considerably from alter reports. Future studies should therefore rely only on the more reliable alter measurements instead of using self-perceptions of degree, especially when considering affective relations.

Finally, this study offers a contribution to the field of social network research. First, recent calls have been made for insights to be gained into the individual (psychological) antecedents of network positions (Kalish & Robins, 2006; Klein et al., 2004; Mehra, Kilduff, & Brass, 2001). A small but growing number of social network studies have examined the psychological antecedents of network structures. Mainly the 'big five personality traits' and self-monitoring have been studied in relation to network structure (Kalish & Robins, 2006; Klein et al., 2004; Mehra et al., 2001; Sasovova, Mehra, Borgatti, & Schippers, 2010). Even though conceptually a certain degree of ambiguity remains with regard to whether goal orientations are traits – or instead semi-traits, mental frameworks, beliefs, or goals – goal orientation is an important individual-level construct, giving individuals the motivation for particular behavior in achievement situations (DeShon & Gillespie, 2005). This study adds to this strand of research by examining goal orientations (a personal characteristic specifically relevant in a context where individuals have to perform) in relation to structural network characteristics. Further, this study examines emotional and adversarial (e.g. distrust) relations, which are in contrast to instrumental work relations and which have been under-studied in organizational social network research (Kratzer et al., 2005). Adversarial relations are difficult to avoid, as members rely on coworkers for the accomplishment of their tasks, especially within a team context. This interdependency reduces the possibility for individuals to break particular relations. Hence, adversarial relations are especially important to study in relation to antecedents and outcomes (Kalish & Robins, 2006; Labianca, Brass, & Gray, 1998; Xia, Yuan, & Gay, 2009).

This study is not without limitations. The main one is the cross-sectional design, as a result of which it is problematic to determine causality. Even though, due to the design of the study, no certainty exists of the direction of a relationship, the arguments have a clear theoretical foundation that indicates the explained direction. Common-source bias is not a concern for most hypotheses. The variables in this study are based on information from objective sources (e.g. team size), from the respondents (e.g. achievement goals and [ego] degree measurements), and from multiple coworkers (e.g. [alters] degree alters measurements). The only concern regards the relationship between achievement goals and the (ego) degree measurements, as the data for both is provided by the respondents. As mentioned in the measurements section, two measurements for degree are available: ego and alters. Of these, the alters measurement is the most reliable, as it is based on the perceptions of multiple individuals. However, for reasons of comparability with existing research (which has relied mainly on the ego perceptions of the network), we decided to include the ego measurements as well. Finally, due to the use of a single-item measurement for trust and distrust (an accepted practice within social network research), the reliability of the

measurement may be reduced. Even though validated psychometric scales are available for trust and distrust, a single-item sociometric approach is preferred due to the need to collect data from individuals concerning their interpersonal relationships with all other team members (Ferrin, Dirks, & Shah, 2006; Grosser, Lopez-Kidwell, & Labianca, 2010; Lau & Liden, 2008). A multi-item scale would cause respondent fatigue, especially for large teams, leading to data with questionable face validity. To addresses this problem and in order to gather reliable and valid data, we relied on standard sociometric methods.

To conclude, the majority of research to date on the relational implications of achievement goals has been of an experimental design. However, to adequately investigate the social context and implications of achievement goals, field studies are recommended. By examining achievement goals within a work team context, the social constraints that influence social behavior are taken into account. In this way, we find results that contrast with expectations based on former experimental studies, but give a more accurate insight into how achievement goals influence the social behavior of individuals.

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4. A NETWORK PERSPECTIVE ON TEAM INNOVATION CLIMATE.

Team innovation climate and team network structures are two team-level constructs that have developed separately within distinct disciplines, but both have been found to contribute to the performance of research teams. Team innovation climate, seen as a social-cognitive construction of in-role work behaviors, is argued to relate to team network structures, as team interactions are crucial for the completion of research tasks. Analyses of the structural characteristics of six networks for 37 teams reveal that two dimensions of team innovation climate (i.e. participative safety and support for innovation) relate strongly to closure structures for instrumental and positive affective relations. A third dimension (interaction frequency) relates to sparse and fragmented negative affective networks and closed friendship networks. As a fourth and a fifth dimension of team innovation climate (vision and task orientation) do not relate to team network structures, the findings show that there is both overlap and complementarity between team innovation climate and team network structures. Hence, it is concluded that literature regarding these factors should be integrated so that understanding is advanced regarding the way in which the team context can be beneficial for innovative team performance.

The innovative potential of organizations lies at the team level, as it is within a team that ideas are proposed and further developed (Hulsheger, Anderson, & Salgado, 2009). Through teamwork, guided by informal interactions among researchers, teams are able to address the complexities related to innovative research tasks. Many research activities have therefore been carried out in teams (Cohen, Kruse, & Anbar, 1982; Lee & Bozeman, 2005). Research teams occupied with innovative tasks, such as developing theories and new applications, benefit from a team climate that stimulates innovation (Anderson & West, 1998; Pirola-Merlo, 2010). This creates the perception of belonging to a team and motivates team members to display appropriate group behaviors. Team and organizational climates are a social-cognitive construction of the in-role work behavior of employees, which is derived from the managerial policies and practices that support and reward this behavior (Zohar & Luria, 2004). It is expected that a team innovation climate comprises social interactions – which are crucial behavior for research tasks – as in-role behavior. Accordingly, this study examines how team innovation climate is associated with relational team network structures.

By establishing the extent to which team innovation climate is associated with relational structures at the team level, and by examining which relational structures underlie team innovation climate, a better understanding is gained about which social behaviors are stimulated or constrained through team innovation climate. In this way, social network analysis can provide the team climate literature with a more direct and adequate method to measure social interactions. Furthermore, at the moment, team climate studies and team network studies still form two distinct streams of literature which both examine how the social work environment influences team performance. The two perspectives studied here have grown from two distinct disciplines: the network perspective from within sociology and the team climate perspective from within psychology. The diverse understandings offered by these different perspectives are valuable, as different aspects are studied, thus broadening knowledge about team performance. However, once the extent of the overlap and complementarity between the concepts has been established, a basis can be provided for the integration of these two bodies of literature, resulting in more in-depth and detailed insights into how the social team context stimulates innovative team performance. Studying the possibility of integrating these two strands of literature is relevant, as the team literature is fragmented and discipline-bound, with only a small number of researchers working on small teams within each of the disciplines. In particular, several scholars have pointed out that the sociological and psychological studies remain rather separate, with little cross-fertilization. However, this separation is artificial, limits theoretical growth and keeps the

team literature from gaining more visibility and importance as a subject (Friedkin & Johnsen, 2011; Poole, Hollingshead, McGrath, Moreland, & Rohrbaugh, 2004).

4.1 Team Innovation Climate

Climates have most frequently been studied at the organizational level, where climate dimensions have been defined in relation to a broad number of organizational behavior constructs, including for example leadership (with climate dimensions such as leaders' psychological distance and leader support), communication (with climate dimensions such as open-mindedness and warmth), and organizational effectiveness (with climate dimensions such as risk orientation and overall quality) (Glick, 1985). A climate is the members' shared perceptions of the work environment (James et al., 2008). These perceptions are formed when individuals give meaning to their work environment, which comprises their jobs, co-workers, leaders, expectations concerning behavior and performance, procedures, team processes, etc. Team innovation climate is a domain-specific climate, focusing on team characteristics that are relevant for innovative tasks within teams. It comprises the shared perceptions of all team members on five dimensions: interaction frequency, support for innovation, participative safety, task orientation, and shared vision (Anderson & West, 1998; West & Anderson, 1996).

To some degree, each of these five dimensions of team innovation climate can be shown to refer to instrumental and/or affective relations. First, interaction frequency is the extent to which team members have contact with each other, both formally and informally (Anderson & West, 1998; West & Anderson, 1996). The perceptions of interaction frequency within a team will stimulate or inhibit team members with regard to further interaction. Interaction frequency can reflect how members work together, as well as the friendly, non-work related talks that members have in order to keep in touch and up-to-date with the others about work and non-work related matters.

Second, participative safety is the extent to which participation is facilitated by the team and the level of interpersonal safety that is experienced. Participation and interpersonal safety are beneficial for innovation, because they foster the commitment to innovate and facilitate social exchange (Anderson & West, 1998; West & Anderson, 1996). Third, support for innovation is the extent to which the team supports attempts to introduce and implement innovative ideas, through the expectations of the team, team approval, and/or practical support. Support for innovation motivates individuals to innovate and addresses practical needs (Anderson & West, 1998; West & Anderson, 1996). Participative safety and support for innovation motivate individuals to participate in the innovation process and thus to share knowledge, cooperate with other team members, brainstorm with others, etc.

Fourth, task orientation is the commitment to excellence in performance and involves constructively challenging the group's objectives, strategies, processes, and performance, with a view to raising standards of performance. Task orientation leads to more creative ideas of higher quality (Anderson & West, 1998; West & Anderson, 1996). Task orientation concerns improving task work rather than teamwork. However, with a view to improving task work, team members will be stimulated to debate with each other, discuss points of improvement, set up meetings, give advice, etc.

Finally, vision is the extent to which a team has objectives that are clearly defined, have a visionary nature, are attainable, and are shared. Vision enables the focused development and assessment of innovative ideas. Commitment to team objectives is necessary to sustain implementation, even if there is resistance (Anderson & West, 1998; West & Anderson, 1996). Vision creates the perception of being a member of a team and makes team members behave accordingly. Vision indirectly makes team members feel closer.

This brief description of the five dimensions of team innovation climate shows that each of the dimensions refers implicitly or explicitly to instrumental and positive affective relations. In the remainder of this section, these five dimensions are linked to different team network structures.

4.2 Team Network Structures

The networks within research teams are multiplex, consisting of both instrumental and affective relations. Instrumental relations – such as giving advice, cooperation, knowledge sharing, problem solving, consultation, and technical-related communication – have been studied frequently in previous team research (Henttonen, 2010). Affective networks can comprise positive relationships, such as socializing and friendships; or negative ones, such as dislike, distrust, or hindrance (Henttonen, 2010). Affective relations can stimulate or inhibit the motivation of a team member to be creative and to innovate (Madjar, 2008; Shalley, Zhou, & Oldham, 2004), while instrumental relations give the necessary input (e.g. technical skills, specific knowledge) for team members to innovate (Kijkuit & van den Ende, 2007, 2010). Both instrumental and affective relations thus affect the process of innovation. Accordingly, the structures of three types of networks are examined here in relation to team innovation climate: instrumental, positive affective, and negative affective.

Team-level network structures can be divided into two dimensions: closure and fragmentation (Henttonen, 2010; Oh, Chung, & Labianca, 2004). Closure implies that individuals are closely interconnected. Coleman (1988) argued that closure gives benefits due to the proximity of others.

More specifically, in closed team networks the presence of shared norms creates a cooperative, cohesive environment that promotes trust. Closure reduces opportunism, the need for monitoring, and transaction costs (Oh et al., 2004). The second dimension of network structures is related to social fragmentation. Social fragmentation structures point to more centralized structures, resulting in less direct contact between team members and the existence of subgroups within the team network.

Networks differ in the level of both closure and fragmentation, creating distinct structures. When the level of both closure and fragmentation is high, the network is made up of distinct subgroups, whereas if both are low, the network consists of a few isolated dyads. When closure is high and fragmentation is low, the members of the network are highly interconnected without the formation of subgroups, whereas when closure is low and fragmentation is high, the few relationships that exist are centered around one individual.

Specifically for instrumental relationships, such as technical communication or work-related interaction, structures of closure are an indication of a team's capacity to coordinate its tasks and teamwork, and are therefore found to be conducive to innovative team performance (Cummings & Cross, 2003; Henttonen, 2010; Kratzer, Leenders, & Van Engelen, 2010; Reagans & Zuckerman, 2001; Sparrowe, Liden, Wayne, & Kraimer, 2001). Structures of fragmentation within an instrumental team network generally do not enhance the team performance (Reagans & Zuckerman, 2001). With regard to affective relations, dense friendship networks have been found to relate to better performance, as these networks facilitate coordination, create positive feelings, and thus enhance individuals' motivation and generate a higher compliance with group goals. However, closed affective networks may lead to groupthink, the lowering of team standards, and the diversion of attention away from work duties. Hence, a moderately dense friendship network with a moderate level of fragmentation is found to relate to the highest innovative team performance (Balkundi, Kilduff, Barsness, & Michael, 2007; Kratzer, Leenders, & Van Engelen, 2005). Finally, networks based on negative affective relations can be examined. In general, the number of negative affective relations present within an organization is small (i.e. one to eight percent of the total number of relationships in an organization) (Labianca & Brass, 2006). The presence of one individual with relationships that are defined as negative (e.g. dissonant, hindering, or distrust) is expected to have a relatively limited impact on team performance. However, if several such people are present, the task work and team work is hindered, producing an adverse effect on team performance (Sparrowe et al., 2001).

Network structures are suggested to relate to the five team innovation climate dimensions. In particular, interaction frequency, participative safety, and support for innovation are three dimensions that are associated with instrumental relations (cooperation, advice giving) and positive affective relations (trust, giving motivational support, keeping in touch). Therefore, high levels of these dimensions are expected to relate to relatively closed instrumental and positive affective networks, and to negative affective networks with low closure. The fragmentation of these networks is expected to be low, because the team climate dimensions do not refer to interactions within only a subgroup of team members. Task orientation brings forward only instrumental relations, such as advice giving, discussing, debating, etc., and is therefore expected to relate to closed and unfragmented instrumental networks. Finally, vision creates a feeling of closeness and therefore is expected to relate to relatively closed and unfragmented positive affective networks, and to negative affective networks with low closure and high fragmentation.

4.3 Method

Research setting and sample

The data used in this study was collected between March 2011 and July 2012 as part of a research project on social networks within research teams. The respondents were all members of research teams within industrial organizations or universities in Flanders. All the industrial teams were embedded in research-intensive industries: specifically, IT and technology, pharmaceuticals, chemistry, and biotechnology. The academic teams were drawn from the academic counterparts of these industries. During a personal meeting, the team leaders were informed about the research project and completed a questionnaire. Data from the team members was gathered by means of a paper questionnaire. In total, 520 questionnaires were distributed among the members (including team leaders) of 37 teams. Out of these, 428 were completed and returned, resulting in an overall response rate of 81.8%. Nine industrial teams, with a total of 75 members, and 28 academic teams, with 353 members, participated. The average size of the teams is 14 (SD = 8.28), with the smallest team consisting of 3 researchers and the largest of 38.

Measurements

Team innovation climate. Team innovation climate is measured using the Team Climate Inventory, developed by Anderson and West (1998). The inventory measures five distinct team dimensions by means of 38 items. Participative safety and support for innovation are measured by eight items each. Interaction frequency is measured with four items. For these three team dimensions, the response format ranges from 1 (strongly disagree) to 5 (strongly agree). Task orientation is

measured using seven items with a response format ranging from 1 (very little extent) to 7 (a great extent). Finally, vision is measured with 11 items. The response format ranges from 1 (not at all) to 7 (completely). The reliability scores for the five dimensions are between .88 and .94.

Social networks. Social network data is collected using sociometric methods. Three rosters that included all team members were given to each of the participants. In the first roster, the respondents had to indicate in two separate columns which team members they a) cooperated with and b) gave advice to. This roster provides details of two separate networks, one for cooperation and one for advice giving. In the second roster, the participants had to indicate how they perceived their affective relationship with each of the other team members. The possible answers are in line with the affective stages identified by Van de Bunt, Van Duijn, and Snijders (1999), and are: 1) true friend, 2) friendship, 3) friendly relationship, 4) neutral relationship, 5) dissonant relationship, and 6) unknown. Both the friendship network and dissonant relations network are derived from this roster. All the relationships that were given a value of 1 or 2 on the scale are identified as friendship relations. All the relationships that were given a value of 5 on the scale are identified as dissonant relations. Finally, in the third roster, the respondents gave their perceptions of the trustworthiness of other team members by indicating on a scale from 1 (completely distrust) to 7 (completely trust) how much they distrusted or trusted the other members of their team. Both the trust and distrust networks are derived from this third roster. All the relationships that were given a value of 6 or 7 on the scale are identified as trust relations. Relationships with a value of 5 ('rather trust') were not included as trust relations, because individuals have been found to respond to some extent in a socially desirable fashion on items of interpersonal trust (Rotter, 1967). In this way, neutral trust relations would also be described as 'rather trust'. All the relationships with a value of 1, 2, or 3 on the scale are identified as distrust relations. The friendship, trust, and distrust networks were coded as digraphs (i.e. dichotomous networks). In short, from the three rosters, six networks were created for the following relationships: cooperation, advice giving, friendship, dissonant relation, trust, and distrust. Missing values for relationships were set to zero. For these networks, five measurements concerning the network structure were calculated. All these network measurements took into account that the networks are directed, i.e. that there is a direction in a relationship, from respondent A to respondent B.

Closure. Three network structures are identified that reflect closure: density, reciprocity, and transitivity. The first and most frequently used measurement for closure is density. Density is the proportion of relationships actually present in a network. Second, reciprocity is the proportion of

relationships that are mutual or reciprocal. More specifically, a relationship is reciprocal when both a relationship from person A to person B and from person B to person A are present. Third, transitivity is the proportion of triads (a group of three people) that are closed, in other words each member of the triad has a relationship with both other members. For directed networks, as is the case in this study, triads with ties from A to B and from B to C, are transitive only if there is also a tie from A to C (Wasserman & Faust, 1994). For instance, in the cooperation network this would mean that 'the friend of my friend becomes my friend'. For negative networks, transitivity theoretically does not hold water, because for example an enemy of my enemy will become my friend not my enemy. Therefore, transitivity is not examined with regard to negative networks.

Social fragmentation. Social fragmentation within a network can be identified by two network structures: centralization and segmentation. First, centralization, which is most often used to operationalize social fragmentation, is the extent to which the relationships within a network are organized around a particular focal actor (Wasserman & Faust, 1994). We measure indegree centralization: the extent to which a network is centralized around individuals who other team members indicated they had for example a cooperative relation with or felt a certain affective relationship with. Second, segmentation is the extent to which disjointed cliques exist in a network. A high level of segmentation means that there are very few relevant indirect relations that connect subgroups, while each subgroup contains many direct relations (Baerveldt & Snijders, 1994). For this study, the proportion of indirect relations with a minimum shortest path length of three is compared with the total number of indirect relations. As with transitivity, segmentation is also of little relevance when considering negative relations, and thus is also excluded from the analyses below.

Analysis

This study investigates the team network structures associated with team innovation climate. The relationships between the team innovation climate variables and the network structure variables are examined by means of bivariate analysis. First, for each of the bivariate relationships, both a linear and a quadratic regression are fitted. By testing the significance of the difference in R^2, it was possible to decide whether a bivariate relationship was best examined as linear or quadratic. In the next step, the correlations for each set of variables are calculated.

Even though this study is based on 428 respondents, the actual sample size for the analyses is 37 (the number of teams). Before analyzing team innovation climate as a team-level variable, it is

necessary to determine whether the team innovation climate variables can be aggregated to the team level. To examine the interrater agreement, both the $r_{wg(j)}$ measurement and the absolute deviation (AD) index are calculated for each of the five team climate dimensions. Values of $r_{wg(j)}$ below 0.70, and AD values higher than c/6 (c = number of answering categories per item) are an indication of insufficient agreement among the team members. If a team did not meet the standards of $r_{wg(j)}$ or was above the maximum for the AD index more than three times, the team was indicated as having low agreement among its members. This was only the case for team 17 (7 non-agreement values) and team 20 (5 non-agreement values). Thus, we can conclude that for most teams, the dimensions underlying team climate are team-level constructs. The two teams that did not meet the standards are excluded from the analyses. In the following section, we present the analyses of how team innovation climate (indicated as mean values per team) and team network structures are related.

Before carrying out the analyses, the variables were examined for anomalous values and outliers. One network measurement had to be excluded from the analyses, as analyses with this variable were not expected to be reliable. More specifically, the segmentation measurement for cooperation had the value of zero for 32 teams. Hence, the variance in the variable relies solely on the five teams that had a value other than zero.

Second, the presence of univariate and bivariate outliers was examined. For each network measurement, influential outlier teams (i.e. when the presence of these teams considerably altered the results) were deleted. Five network structure variables had an outlier that had considerable effects on the results of the analyses: density of the advice giving network, transitivity and segmentation of the friendship network, and segmentation of the trust network. From the reciprocity of the friendship network, three outliers were deleted.

Caution is warranted when executing a large number of statistical test on a dataset. In this paper, 125 correlations are calculated. With an increase in the number of significance tests executed, also the likelihood of rejecting a null hypothesis, when it is actually true (type I error) (Selvin, 1957). However, the chance of finding 26 or more significant results which are in fact type one errors when executing 125 significance tests at the 5% level is 5.742E-10. From this it can be concluded that the number of significant results are not largely inflated due to capitalizing on chance and that no adjustments of the level of significance need to be taken into account (Perneger, 1998; Selvin, 1957).

4.4 Results

The five team innovation climate dimensions correlate moderately to highly with each other, with intercorrelations ranging from .32 to .76 (see Table 4.1). Even though the five dimensions are integrated into the Team Climate Inventory, they are existing scales which were and are continued to be used as separate concepts within the literature (Anderson & West, 1998; Eisenbeiss, van Knippenberg, & Boerner, 2008; Hulsheger, Anderson, & Salgado, 2009; Pirola-Merlo, Härtel, Mann, & Hirst, 2002; Schulte, Cohen, & Klein, 2012). In line with this practice, the five team innovation climate dimensions are included in the analyses as separate concepts rather than one combined team innovation climate.

Table 4.1

Means, standard deviations, and intercorrelations for the team innovation climate variables (N = 35)

	M	SD	1	2	3	4
Interaction frequency	3.98	0.32				
Participative safety	3.90	0.35	0.62			
Support for innovation	3.91	0.32	0.62	0.69		
Task orientation	4.81	0.48	0.51	0.57	0.76	
Vision	5.29	0.41	0.32	0.46	0.61	0.63

The mean scores and standard deviations for the network structure variables are shown in Table 4.2. Even though the six relationships have distinct contents, they can be grouped into two different types based on the network structure variables. The first type comprises relationships with a content that has a negative connotation (i.e. dissonant relationships and distrust). These two networks have on average a very low density, very high reciprocity, and low centralization. Thus, only a small number of dissonant or distrust relationships exist. The dissonant and distrust networks can be visualized as almost empty networks, wherein one or more dyadic of triadic relationship structures are present.

The structural variables are not independent of each other (see Appendix 4A for the exact intercorrelations). However, since analyses in this study are bivariate and thus do not include more than one structural variable, there are no methodological problems related to multicollinearity. However, in the interpretation of the results, highly correlated structural variables are expected to bring forward similar results. For example, transitivity measures are highly correlated to the density measures in the cooperation. In the cases when these variables

give significant correlations, it is not clear whether the effect is due to the rise in density or the transitive effect, since transitivity is heavily dependent upon the amount of relations present in these networks. Thus, when highly correlated structural variables yield significant results, the results should be interpreted with more caution.

Networks of the second type consist of both two instrumental networks (cooperation and advice giving) and two positive affective networks (friendship and trust). In general, we find that a medium to high proportion of the possible relationships actually become established. Within these networks, relationships are very often reciprocated and are often part of a larger triadic structure. Social fragmentation is not strongly present in the instrumental and affective networks. Thus, networks of this second type are characterized as moderately dense structures, with a relatively equal distribution of the relationships across the team members and with a moderate tendency to be centralized around certain focal individuals. Subgroups of highly interacting individuals who are separated from the other group members do not exist. The standard deviations of the network structure measurements for this network type are moderate, indicating that the teams in the sample vary in the structure of these networks.

As the sample is composed of both academic and industrial teams, an examination of whether the two groups differ in terms of the variables in this study is indispensable. Welch's F tests were carried out for each of the team innovation climate and network structure variables. No significant difference in means between the two groups is found for most variables. Nonetheless, some differences are found, which are reported here. First, academic teams are rated lower for participative safety (M = 3.80, SD = .25) within the team than industrial teams (M = 4.21, SD = .43), $F(1, 9.97) = 7.37$, $p = .022$.

Table 4.2

Means and standard deviations for each of the network measurements per type of relation (N = 35)

	Cooperation		Advice giving		Friendship		Dissonant		Trust		Distrust	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Density	0.41	0.24	0.36	0.19	0.27	0.13	0.02	0.03	0.56	0.17	0.03	0.03
Reciprocity	0.75	0.13	0.65	0.13	0.71	0.13	0.97	0.04	0.59	0.11	0.94	0.06
Transitivity	0.55	0.24	0.62	0.16	0.61	0.23	-	-	0.78	0.11	-	-
Centralization	0.32	0.17	0.37	0.16	0.24	0.10	0.09	0.12	0.26	0.10	0.15	0.14
Segmentation	-	-	0.14	0.19	0.27	0.26	-	-	0.01	0.01	-	-

Second, differences are found for two network measurements of the advice giving network. The academic teams have a more segmented structure (M = 0.19, SD = .20) than the industrial teams (M = 0.02, SD = .04, F(1, 28.83) = 16.84, p = <.001). In addition, the advice giving networks of the academic teams are less dense (M = 0.30, SD = .14) than those of the industrial teams (M = 0.51, SD = .24, F(1, 10.10) = 6.11, p = .033). Finally, significant differences in means are found for three network measurements of the cooperation network. The academic teams are found to have a significantly lower transitivity in the cooperation network (M = 0.47, SD = .22) than the industrial teams (M = 0.78, SD = .12, F(1, 26.85) = 28.12, p = <.001). The mean density of the cooperation networks is lower for the academic teams (M = 0.33, SD = .18) than for the industrial teams (M = 0.64, SD = .23, F(1, 11.81) = 14.30, p = 0.030). In addition, a higher mean centralization is found for the academic teams (M = 0.36, SD = .17) than for the industrial teams (M = 0.18, SD = .11, F(1, 22.41) = 14.58, p = .001).

For each of the six networks, the relationship between team innovation climate and network structures is now examined (see Table 4.3). First, the congruency between cooperation network structures and the team innovation climate dimensions stays limited to two dimensions: participative safety and support for innovation. Both dimensions correlate positively with the density of the cooperation network. Furthermore, participative safety correlates positively with the transitivity of the network. Thus, the cooperation network structures related to team innovation climate are transitivity and density – both structures that indicate closure.

Second, for the advice giving network, we find that density correlates positively with four team innovation climate dimensions: participative safety, support for innovation, task orientation, and vision. Transitivity correlates with participative safety and support for innovation. Furthermore, segmentation is negatively correlated with participative safety. Finally, two curvilinear correlations (both u-shaped) are found for centralization: support for innovation and participative safety are both highest when centralization is either very high or very low. Thus, the advice giving networks related to high team innovation climate are dense and transitive, with lower levels of segmentation and are either highly or weakly centralized.

Third, with regard to the friendship network structures, transitivity is positively correlated with interaction frequency, participative safety, and support for innovation. In addition, participative safety correlates positively with density. Finally, centrality in the friendship network is quadratically correlated (u-shaped) with participative safety. Hence, the friendship network structures related to high team innovation climate are density and transitivity, and either high or low centrality.

Fourth, for the dissonant network a negative significant relationship is found between interaction frequency and centralization. In general, the number of dissonant relationships per network is very limited. The negative relationship between interaction frequency and centralization indicates that for networks with a high level of innovation climate, the dissonant ties that are present do not point toward one individual.

Table 4.3

Correlations between team innovation climate processes and network structures (N between 32 and 35)

(p-values for significance levels between brackets)

		Interaction frequency		Participative safety		Support for innovation		Task orientation		Vision	
		x	x^2	x	x^2	x	x^2	x	x^2	x	x^2
Cooperation	transitivity	-.14		**.43**		.32		.33		-.01	
		(.428)		(.011)		(.059)		(.056)		(.965)	
	density	-.11		**.50**		**.35**		.28		.11	
		(.515)		(.002)		(.043)		(.110)		(.538)	
	reciprocity	.10		.02		-.17		-.14		-.01	
		(.573)		(.926)		(.344)		(.422)		(.977)	
	centralization	.08		-.24		-.14		-.16		-.00	
		(.645)		(.169)		(.424)		(.346)		(.981)	
	segmentation	**-**		**-**		-		-		-	
		-		-		-		-		-	
Advice giving	transitivity	.08		**.50**		**.34**		.31		.15	
		(.642)		(.003)		(.044)		(.069)		(.403)	
	density	.26		**.70**		**.44**		**.39**		**.37**	
		(.133)		(.000)		(.009)		(.022)		(.029)	
	reciprocity	.10		.02		-.11		.02		-.02	
		(.585)		(.893)		(.529)		(.933)		(.894)	
	centralization	-.14			**.65[u]**		**.47[u]**		.40	-.11	
		(.435)			(.001)		(.017)		(.062)	(.522)	
	segmentation	-.06		**-.37**		-.13		-.12		-.08	
		(.738)		(.029)		(.453)		(.505)		(.661)	
Friendship	transitivity	**.36**		**.39**		**.37**		.02		.24	
		(.038)		(.022)		(.033)		(.905)		(.167)	
	density	.20		**.36**		.17		.16		.09	
		(.256)		(.033)		(.336)		(.370)		(.622)	
	reciprocity	-.14		-.24		-.01		.11		-.15	
		(.447)		(.195)		(.948)		(.559)		(.412)	
	centralization	.29			**.45[u]**	.20		.15		.20	
		(.096)			(.028)	(.254)		(.379)		(.259)	
	segmentation	-.23		-.27		-.08		-.13		-.08	
		(.202)		(.124)		(.643)		(.478)		(.665)	

(Table 4.3 continued)

		Interaction frequency		Participative safety		Support for innovation		Task orientation		Vision	
		x	x^2	**x**	x^2	x	x^2	x	x^2	x	x^2
Dissonant	transitivity	**-**		**-**		-		-		-	
		-		-		-		-		-	
	density	-.32		-.14		-.09		-.04		-.26	
		(.065)		(.439)		(.622)		(.804)		(.138)	
	reciprocity	.33		.16		.12		.06		.23	
		(.056)		(.346)		(.491)		(.724)		(.192)	
	centralization	**-.39**		-.23		-.22		-.15		-.31	
		(.021)		(.195)		(.206)		(.394)		(.072)	
	segmentation	-		-		-		-		-	
		-		-		-		-		-	
Trust	transitivity	.28		**.43**		**.35**		.05			.16
		(.104)		(.004)		(.035)		(.788)			(.057)
	density	.17		**.43**		**.35**		.03		.14	
		(.319)		(.010)		(.038)		(.874)		(.421)	
	reciprocity	.10			.41	.04		.06			.39
		(.571)			(.053)	(.813)		(.744)			(.073)
	centralization	-.11			**.46**[u]	-.18		.01		.29	
		(.543)			(.021)	(.289)		(.978)		(.091)	
	segmentation	-.09		-.09		-.03		.14		.15	
		(.620)		(.616)		(.883)		(.434)		(.396)	
Distrust	transitivity	-		-		-		-		-	
		-		-		-		-		-	
	density	**-.37**		-.24		-.18		-.06		-.15	
		(.029)		(.158)		(.297)		(.729)		(.404)	
	reciprocity	**.41**		.26		.24		-.02		.15	
		(.014)		(.132)		(.162)		(.929)		(.380)	
	centralization	**-.36**		-.32		-.25		.01		-.26	
		(.036)		(.060)		(.153)		(.947)		(.129)	
	segmentation	**-**		-		**-**		-		-	
		-		-		-		-		-	

[u] the quadratic relation has a u-shape

Fifth, with regard to the trust network, support for innovation and participative safety correlate positively with density and transitivity. In addition, participative safety correlates quadratically with centralization (u-shaped). These results lead to the conclusion that team innovation climate correlates with closed trust networks.

Finally, for the distrust network, interaction frequency correlates positively with reciprocity and negatively with density and centralization. Thus, the distrust network structures related to team

innovation climate are low density, low centrality, and high reciprocity. This implies that a high level of team innovation climate relates to distrust networks that exist as a result of some isolated, reciprocated dyads.

4.5 Conclusion and Discussion

To conclude, the findings show that dimensions of team innovation climate are congruent with certain network structures. In general, a high team innovation climate is related to dense instrumental and positive affective networks and sparse negative affective networks, which is in line with our expectations. However, not all the examined team climate dimensions are strongly congruent with team network structures. Of all the five team innovation climate dimensions, participative safety and support for innovation are the dimensions that are congruent with a large number of team network structures (mainly transitivity and density of instrumental and positive affective networks). Examining the content of both participative safety and support for innovation, both concepts motivate individuals into participating in the innovation process and thus to sharing knowledge, cooperating with other team members, brainstorming with others, etc. Therefore, the direct and clear relation with the interpersonal interactions among team members is in line with the expectations.

Remarkably, interaction frequency – which measures the frequency of formal and informal interactions – is not correlated with instrumental network structures. Interaction frequency relates to transitivity in the friendship network, decentralized dissonant structures, and the presence of only a small number of isolated, reciprocated dyads in the distrust network. This shows that a high interaction frequency actually indicates the team members get along well with each other and that they do not hold negative feelings toward one specific team member (i.e. the 'black sheep' of the team).

Finally, task orientation and vision only correlate to a very limited extent with network structures. A possible explanation for the absence of a relationship is that these concepts are expected to only indirectly stimulate social interaction. The main focus of these concepts is on enhancing task work and creating the perception of being a member of a team, which makes team members behave accordingly.

The results of this study show that three team innovation climate dimensions relate to team network structures: interaction frequency, participative safety, and support for innovation relate to closed structures of the instrumental and positive affective network and to fragmented negative affective networks. The network structures that relate to the climate dimensions have all

been found to contribute to higher innovative performance in teams. However, remarkable results are found for the centralization of the advice giving, friendship, and trust networks. As expected, high participative safety and support for innovation are related to low centralization, and thus low fragmentation. Unexpectedly, participative safety and support for innovation are also high when there is a high level of centralization. In teams with higher centralization for these networks, the central person seems to have a motivational role and leaves room for participation. High levels of centralization are found to be detrimental for team performance in terms of instrumental relations (Reagans & Zuckerman, 2001). For positive affective relations, a moderate level of centralization is most productive (Balkundi et al., 2007; Kratzer et al., 2005). Thus, even though participative safety and support for innovation is high in teams with a high level of centralization, it can be questioned whether this will actually result in high team performance.

Through this study, a better understanding is created about how team innovation climate can contribute to the higher innovative performance of teams. As the contribution of both team climate and network structures have been previously studied with regard to team-level innovation, the question can be asked of the degree to which these concepts overlap and accordingly, how far the relevant strands of literature can be integrated in order to improve our understanding of how the team context stimulates innovative team performance. Reference has been made to social interactions in previous team innovation climate research, but no research attention has been paid to the configuration these interactions are structured in. The results of this current study show that there are points of overlap, but also points of complementarity between team innovation climate and team network structures. The call for integration is even more pertinent when considering that critique can be given to existing network studies, as they use team properties – such as cohesive environment or cooperative environment – to make the closure argument, but leave these properties unclearly defined and unexamined.

This study thus ends with a clear agenda for future research. Psychological studies on team climates will be enriched when the underlying social relationships and their structures are examined further. For example, the influence on team climate of the presence of strong subgroups within a team could be explored. Team network studies would benefit from going into more detail regarding the team characteristics underlying structural configurations. With this study as a first example, the general proposition that closure brings a cohesive or cooperative environment should be further extended and empirically investigated. In this regard, it could also be relevant to address other climate dimensions. Ultimately, research should jointly examine team climate and network structures in terms of their relationships to team outcomes.

Appendix 4A

Correlations among the structural variables

		transitivity	density	reciprocity	centralization
	transitivity				
	density	0.82 ***			
Cooperation	reciprocity	-0.44 **	-0.33		
	centralization	-0.53 ***	-0.38 *	0.20	
	segmentation				
		transitivity	density	reciprocity	centralization
	transitivity				
	density	0.62 ***			
Advice	reciprocity	-0.22	-0.03		
	centralization	-0.23	-0.24	-0.41 *	
	segmentation	-0.09	-0.59 ***	0.37 *	-0.08
		transitivity	density	reciprocity	centralization
	transitivity				
	density	0.35 *			
Friendship	reciprocity	-0.58 ***	-0.48 **		
	centralization	0.35 *	0.49 **	0.00	
	segmentation	-0.01	-0.60 ***	0.52 **	0.05
		transitivity	density	reciprocity	centralization
	transitivity				
	density				
Dissonant	reciprocity		-0.97 ***		
	centralization		0.92 ***	-0.94 ***	
	segmentation				
		transitivity	density	reciprocity	centralization
	transitivity				
	density	0.74 ***			
Trust	reciprocity	-0.34 *	0.08		
	centralization	-0.05	-0.07	-0.36 *	
	segmentation	-0.49 **	-0.38 *	0.15	-0.04
		transitivity	density	reciprocity	centralization
	transitivity				
	density				
Distrust	reciprocity		-0.98 ***		
	centralization		0.83 ***	-0.83 ***	
	segmentation				

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5. TRUST FOR COOPERATION? A CONTEXTUAL APPROACH ON MULTIPLEX TRUST-COOPERATION RELATIONS.

High levels of interpersonal trust within a team have been thought to stimulate cooperation, consequently also enhancing team performance. Even though this line of thinking is dominant in the trust literature, there are indications that trust does not always result in higher cooperation and performance. This study examines the multiplexity between trust and cooperation and argues that three dimensions of team innovation climate (participative safety, interaction frequency, support for innovation) are contextual factors which influence the multiplexity. The analyses of the proportion of three types of multiplex configurations (strong cooperation, weak cooperation and trust without cooperation relations) for 37 teams revealed that the dimensions of team innovation climate stimulate strong relations of cooperation, and decrease the proportion of relations of weak cooperation. This makes these dimensions a more suitable analytical concept than trust when discussing the issue of altering the level of cooperation within a team.

Often, the organizational trust literature has described cooperation as a productive outcome of trust, by which trust stimulates the organizational performance (Dirks & Ferrin, 2001). This perspective resulted in the prescription of numerous interventions to improve organizational performance through the stimulation of trust. Even though these interventions were found successful in increasing the levels of trust, their impact on performance was less consistent (Dirks & Ferrin, 2001). The reason that increasing trust does not always result in higher levels of team performance is that trust does not always lead to higher levels of cooperation. For example, trust relations will only result in cooperation in situations where cooperation is relevant (i.e. when there is a need for expertise or skills that can be fulfilled by others) and is a formally and/or socially prescribed behavior. In addition, in situations where there is low vulnerability related to cooperation or where external control mechanisms are present, cooperation can exist between individuals that do not trust each other (Cook, Hardin, & Levi, 2007; Dirks & Ferrin, 2001; Mayer, Davis, & Schoorman, 1995). These examples show that social expectations and social control related to cooperation are influencing the existence of multiplexity (i.e. overlap of relations) between trust and cooperation. Since these social expectations and social control are contextual, this study focuses on contextual factors that influence the proportion of strong cooperation (i.e. coinciding trust and cooperation), weak cooperation (i.e. cooperation without trust) and trust-only (i.e. trust without cooperation) relations within a team network.

The focus of this study lies on the multiplexity of trust and cooperation within a research team context. Within research teams, cooperation is important for the completion of individual and team goals, because research requires a combination of multiple researchers' skills and expertise (Chen, Chang, & Hung, 2008; Hagstrom, 1964; Henttonen, Janhonen, Johanson, & Puumalainen, 2010; Katz & Martin, 1997; Lee, Wong, & Chong, 2005). Trust has been shown to be crucial for research tasks, since useful and complex knowledge is only accessed through trustful relations, irrespective of the frequency of interaction (Levin & Cross, 2004). Because the sharing of complex knowledge is an important factor for research teams, and trust facilitates this sharing, multiplex trust and cooperation relations are more important for the performance of research teams than weak cooperation relations. By investigating the multiplexity of trust and cooperation relations within research teams, this study aims at uncovering contextual antecedents of strong cooperation relations, which contribute to performance, and weak cooperation and trust-only relations, which are less valuable for performance (Levin & Cross, 2004). Since these informal work relationships are thus an essential part of organizational performance these insights are indispensable.

In past research, team climate dimensions have been studied as contextual factors influencing the relational behavior within work teams (Costa, 2003; Hoegl, Parboteeah, & Munson, 2003; Nuyts & Van Rossem, 2014). In particular within an innovative research team context, team innovation climate dimensions (i.e. interaction frequency, participative safety and innovation support) were found to stimulate the number of interpersonal social interactions, as well as the structure of the team networks that were made up from these social interactions. This study argues that these team climate dimensions create social expectations towards and social control over cooperation and influence the level of interpersonal trust within teams. Hence, it is expected that the dimensions relate to specific multiplex relations. Thus, team innovation climate dimensions are examined in this study as contextual factors influencing the multiplexity between trust and cooperation.

5.1 Contextualizing the trust-cooperation relation

In line with the definition of Mayer, Davis and Schoorman (1995), interpersonal trust is defined as the willingness of an individual to be vulnerable to the actions of a partner based on the expectations that the partner will perform a particular action important to the individual, irrespective of the ability to monitor or control the partner. The extensive trust literature has focused on how trust produces attitudinal, cognitive, behavioral and performance outcomes (for a review see Dirks & Ferrin, 2001). With regard to team performance, the mechanism that is predominantly present in the literature is that when the level of interpersonal trust increases, a team experiences superior group processes (such as cooperation), resulting in higher performance (Dirks, 1999; Dirks & Ferrin, 2001). However, as mentioned already before, trust is not always a prerequisite for cooperation. When the risks and uncertainty related to cooperation are low or when there are control mechanisms present, cooperation can come into existence without trust. In addition, in a context which does not prescribe cooperation as a relevant work behavior, trust relations can exist without them stimulating cooperation. In the remainder of this section, the influence of contextual factors, in particular team innovation climate dimensions, on the trust-cooperation multiplexity is examined.

First, the proportion of strong cooperation (i.e. where trust and cooperation coincide), weak cooperation (i.e. cooperation without trust, but also not distrust) and trust without cooperation relations present in a team is expected to be influenced by three team climate dimensions: participative safety, support for innovation, and interaction frequency.

Participative safety comprises both participation and psychological safety within the team. Participation is examined in relation to the information sharing and decision making process

within the team (Anderson & West, 1998; Hulsheger, Anderson, & Salgado, 2009). Psychological safety within the team refers to a team atmosphere which is nonthreatening and safe for interpersonal risk taking, with high trust and mutual support (Edmondson, 1999; Hulsheger et al., 2009; Schulte, Cohen, & Klein, 2012).

Support for innovation within a team is brought forward through interactions among team members and can be of both motivational or practical nature. The motivational support for innovation stimulates, like participative safety, the general risk-taking behavior of team members (Anderson & West, 1998; Hulsheger et al., 2009). Practical support implies cooperative behaviors of some sort, thus when support for innovation is high, the level of cooperation is expected to be high as well. Even though support for innovation is not theorized to stimulate trust, it would neither be expected to diminish it.

Finally, when the frequency of interaction is high, cohesion within the team is created. Cohesion is theorized to foster mutual trust which facilitates exchange and collective action (Coleman, 1988). In addition, interactions have been found crucial in the formation of active trust. In the beginning of social interactions, when individuals do not have prior knowledge of the other, individuals tend to start with a belief that the other is not untrustworthy. This does not mean the alter is actively trusted, but rather that he is not initially distrusted (Jones & George, 1998). From that starting point onwards, the perception of trust is adjusted quickly with every interaction, resulting in more active trust or distrust (Jones & George, 1998). Thereby also the opinions of third parties, which are accessed through interactions, are influential (Burt & Knez, 1995; Ferrin, Dirks, & Shah, 2006; Lau & Liden, 2008). Hence, interaction frequency is expected to stimulate active trust and distrust relations rather than neutral relations. Since distrust is not frequently present in organizations (Labianca & Brass, 2006), a high interaction frequency is expected to result mainly in active trust.

In conclusion, participative safety stimulates both trust and cooperation relations, while support for innovation facilitates risk-taking behavior such as cooperation and interaction frequency stimulates trust. Even though support for innovation is not expected to actively stimulate trust, there are no indications that it is going to lower the level. Similarly, the frequency of interaction is not going to lower the level of cooperation. Since all three team climate dimensions discussed above thus stimulate trust and/or cooperation, they are expected to stimulate the proportion of strong cooperation relations within the team. Participative safety and interaction frequency are expected to increase the proportion of trust-only relations in cases when cooperation is not relevant. Thus, participative safety and interaction frequency are hypothesized to related to higher

proportions of strong cooperation and trust without cooperation relations, and support for innovation to higher proportion of strong cooperation relations.

Hypothesis 1: Participative safety, support for innovation and interaction frequency relate positively to the proportion of strong cooperation relations.

Hypothesis 2: Participative safety and interaction frequency relate positively to the proportion of trust without cooperation relations.

In situations of weak cooperation relations, it is not relevant whether the team climate dimensions result in high levels of trust within the team, but rather whether they provide control mechanisms that can take over the role of trust in relations where there is no active trust present. Even though the relation between trust and control is still under discussion and some researchers see a trade-off between control and trust (Bijlsma-Frankema & Costa, 2005; Möllering, 2005), this study follows the line of thought that trust and control go hand in hand and complement each other in stimulating cooperation.

Similarly, cohesion, which is brought forward by a high frequency of interaction has been found to result in social control mechanisms. Burt (2010) has argued that cohesive structures constraint the behavior of individuals within the structure. Unlike cohesion, participative safety is not expected to bring forward any social control mechanisms, as it is no more than a sense of confidence that the team will respect the other when participating (Edmondson, 1999). Also support for innovation is rather facilitating and not restraining certain behaviors, and is therefore not expected to bring forward a social control or formal control mechanism. Hence, interaction frequency, but not participation frequency or support for innovation, is expected to facilitate weak cooperation relations. It is therefore hypothesized that interaction frequency relates to higher levels of weak cooperation relations, while participative safety and support for innovation are expected not to affect this proportion.

Hypothesis 3: Interaction frequency relates positively to the proportion of weak cooperation relations.

Hypothesis 4: Participative safety and support for innovation does not relate significantly to the proportion of weak cooperation relations.

5.2 Method

Research setting and sample

Data were collected between March 2011 and July 2012 as part of a research project on the antecedents and outcomes of social relations within research teams. The respondents are all members of research and/or development teams within the industry or universities in Flanders. All industrial teams are embedded in research-intensive industries, i.e. IT or technology, pharmaceuticals, chemistry and biotech. The academic teams came from the academic counterparts of these industries. Team leaders were contacted and asked whether they and their team were willing to participate in this study. During a personal meeting, the leaders were informed in detail about the content and practicalities of the study. The data was gathered by means of a questionnaire. Leaders completed their questionnaire during the personal meeting, while for the team members, the questionnaires were delivered on paper to the leaders for further distribution. After completion, the team members returned the questionnaires in individually sealed envelopes, for reasons of confidentiality. Because network data was collected, the questionnaires could not be anonymous. Nonetheless, the response rate is high. In total, 520 questionnaires were distributed among the team members of 37 teams, of which 428 were received back completed. Hence, the overall response rate is 81.8%. Nine industrial teams, with in total 75 team members, and 28 academic teams, with 353 team members, participated. Within the 37 teams, 9254 dyadic relations can be formed. For the cooperation relations, data is available for 7305 of the dyadic relations (21% missing) and for the trust relations for 6731 (27% missing).

Measurements

Dependent variables

Proportion of weak cooperation, strong cooperation and trust without cooperation relations. For each team, the trust and cooperation network were constructed, based on the data of the individual members. The data was collected by a sociometric gathering procedure. Two rosters which included all team members, were provided to each of the respondents. In the first roster the respondents had to indicate with which team members they cooperated. For each team, this results in a cooperation network in which all relationships that are indicated as a cooperative relation have value 1 and all other relations have value 0. In the second roster, the respondents were asked to indicate on a scale from 1 (completely distrust) to 7 (completely trust) how much they distrusted or trusted the other members of the team to which they belong. All relationships that were given a value 6 or 7 on the scale are identified as active trust relations. All relationships that were given

a value 4 or 5 on the scale are identified as neutral trust relations. All relationships that were given a value 1 to 3 on the scale are identified as distrust relations. Missing values for both networks were set to zero. By summing the trust and cooperation networks, a multiplex network was made. Where cooperation relations coincide with active trust relations, strong cooperation relations are formed. Where cooperation relations coincide with neutral trust relations, weak cooperation relations are formed. Finally, in cases where there is an active trust relation present, but no cooperation relation, trust without cooperation relations are formed. These three multiplex relations were isolated into a separate network and the densities (i.e. the number of established relations as proportion of all possible relations) of these three networks were calculated. These densities indicate the proportion of weak cooperation, strong cooperation and trust without cooperation relations present in a team and are the dependent variables of this study.

Independent variables

Team innovation climate dimensions. Participative safety, interaction frequency and support for innovation are three dimensions from the team innovation climate, which is measured using the Team Climate Inventory, developed by Anderson and West (1998). Participative safety and support for innovation are measured by eight items each. Interaction frequency is measured with four items. The response format for the items ranged from 1 (disagree strongly) to 5 (agree strongly). The reliability scores for these three dimensions range between .90 and .91. Correlations among participative safety, interaction frequency and support for innovation vary between .62 and .69.

Control variables

Team size. Team size is measured as the number of team members (including the direct team leader). When the size of a network grows, the potential number of contacts grows. Individuals will increase their network up to a certain point, after which the increasing costs and diminishing marginal returns refrain the individual from making new contacts. Therefore, at the team level, this will mean that when team size grows, the proportion of possible relations that is established increases up to a certain point, after which it decreases. Thus, team size affects the proportion of team relations that can be established in a non-linear manner. To take this into account, the log-transformed variable of team size is included in the below analyses as control variable.

A*verage team tenure*. Each respondent was asked how many years he/she worked in the team. When teams are established only recently or when new members join (i.e. the mean team tenure is low), the level of socialization is low (Michel & Hambrick, 1992), resulting in a lower level of

trust (Jones & George, 1998) and cooperation. Hence, the median team tenure is included in the analyses as control variable.

Institutional context. Research teams in this study are embedded in either an academic or industrial context. These contexts differ culturally (Bjerregaard, 2010). One particular difference among institutional context is their social expectations towards cooperation. Within the industry, researchers are expected to show loyalty to the organization, conform with established policies and procedures, and follow the line of research as outlined by the organization. In general, teamwork is the standard. In contrast, within universities, researchers are given more independence and are in the possibility to set up self-chosen informal collaborations within the whole research community (Blume, 1974; Box & Cotgrove, 1966; Crane, 1969; Hagstrom, 1964; Sauermann & Stephan, 2010; Webster & Etzkowitz, 1998). Since academic teams have been found to establish less cooperation relations than industrial teams (Nuyts & Van Rossem, 2014), industrial context is included as control variable in the below analyses.

Analysis

The calculations for constructing the dependent variables are based on 6731 dyadic relationships, for which information was available concerning both cooperation and trust. To examine the influence at the team level of contextual factors on the proportion of strong and weak cooperation and trust-only relations, MANOVA was executed to take into account the moderate correlation between the three dependent variables (see Table 5.2). Due to the high intercorrelations between the team innovation climate dimensions (between .62 and .69) it was not possible to include the team innovation climate dimensions in one model. Hence, a MANOVA model is set up for each of the three dimensions.

Before analyzing team innovation climate as a team level variable, a justification on whether the team innovation climate variables can be aggregated to the team level is needed. To examine the interrater agreement, both the $r_{wg(j)}$ index and the absolute deviation (AD) index are calculated for each of the five team climate dimensions. Values of $r_{wg(j)}$ below 0.70, and AD values higher than c/6 (c=number of answering categories per item) are an indication of insufficient agreement among the team members. When a team did not meet the standards of $r_{wg(j)}$ or were above the maximum for the AD index more than 3 times, the team was indicated as having low agreement among the team members. This was the case for teams 17 (7 non-agreement values) and 20 (5 non-agreement values). Thus, we can conclude that for most teams, the dimensions underlying

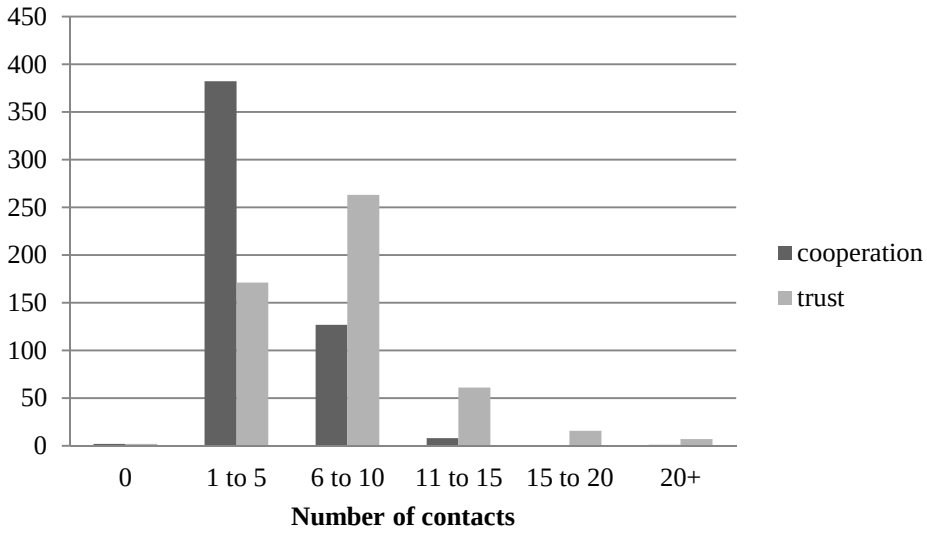
team climate are team level constructs. The two teams that did not meet the standards were excluded from the analyses.

5.3 Results

Before examining the trust-cooperation relation, insight is given into the occurrence of both trust and cooperation relations. Almost all researchers within this sample have contact with one or more team members, for cooperation and trust (Figure 5.1). Considering cooperation, a majority of the researchers has 1 to 5 contacts within their team. A smaller group of researchers cooperates with 6 to 10 team members. Few researchers have more than 10 cooperation relations within the team. Regarding trust relations, the largest proportion of researchers has 6 to 10 contacts. Around 175 researchers trust 1 to 5 team members. Finally, we see that a small share of the researchers have trust relations with more than 10 team members.

Figure 5.1

Frequency of respondents that had a certain number of contacts for cooperation and trust.



Within the research teams, the average density (that is number of established relations as proportion of the total possible number of relations) of the trust network is .56 (*SD* = .17) and of the cooperation network is .41 (*SD* = .24). In general, more trust relations are established than cooperation relations. Academic teams are found to have a significantly lower density in the cooperation network (*M* = .33, *SD* = .18) than the industrial teams (*M* = .64, *SD* = .23, F(1, 11.81)=14.30, p=.030). The average density of the trust networks does not differ significantly between academic teams (*M* = .55, *SD* = .19) and industrial teams (*M* = .58, *SD* = .14, F(1, 17.99)=.11, p=.750). From these findings we can conclude that academia and the industry are

two different settings when it comes to instrumental cooperation relations but not for trust relations. Not only social relations differ with institutional context. Also for participative safety, differences are found. In particular, academic teams are rated lower for participative safety (M = 3.80, SD = .25) within the team than industrial teams (M = 4.21, SD = .43), F(1, 9.97) = 7.37, p = .022. For the other dimensions, no significant differences are present.

The densities of the trust and cooperation networks are correlated with the team innovation climate dimensions. Participative safety and support for innovation correlate moderately positive with the density of trust and cooperation, with correlations varying from .35 to .50. More remarkable, interaction frequency does not correlate significantly with the density of trust or cooperation, with correlations of respectively .17 and -.11.

Table 5.1

Crosstabs of trust and cooperation dyads (N = 6731)

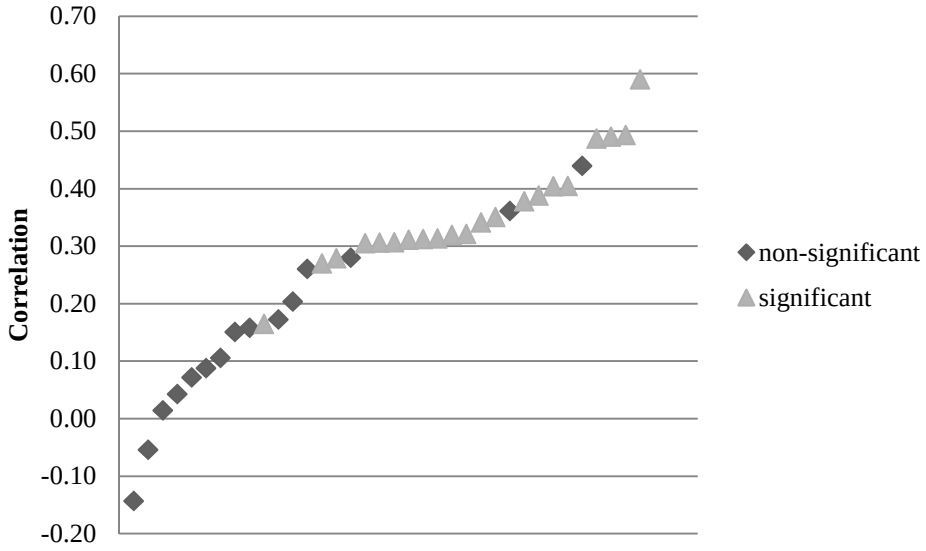
	Distrust	Neutral	Trust	Total
Non-cooperation	242	2100	2227	4569
	5.3%	46.0%	48.7%	100.0%
Cooperation	80	511	1571	2162
	3.7%	23.6%	72.7%	100.0%
Total	322	2611	3798	6731

The multiplexity of dyadic relations is first examined by means of crosstabulating the dyadic cooperation and trust relations. A large majority (73%) of the cooperation relations are also trust relations (Table 5.1). In comparison, for non-cooperation relations only 49% are trust relations. Remarkably, 24% of the cooperation relations are weak cooperation relations, with no active trust, while 4% of the cooperation are also distrust relations. To examine the multiplexity between trust and cooperation within the teams, the correlation (MRQAP) between the trust and cooperation network for each team is calculated (Figure 5.2). For 21 of the 37 teams, a significant correlation was found between the trust and cooperation network. For one team, with a density of 100% for the cooperation network, no correlation can be calculated. A meta-analysis was conducted to examine whether the correlations across the 36 teams can be combined into an overall significant correlation. The mean estimate is a Fisher Z value of 0.31 (SE=.02), which corresponds to a correlation value of 0.30. This mean estimate is significant (z-value is 18.58). The Q-test of this meta-analysis of the MRQAP correlations (Q=55.21; df=35), is significant,

which indicates that the sample is heterogeneous and the relation between the trust and cooperation networks is not the same within the teams.

Figure 5.2

Correlations (MRQAP) between the trust and cooperation network per team



Descriptive statistics of, and bivariate intercorrelations among the main dependent and independent variables of this study are shown in Table 5.2. The dependent variables correlate moderately. In particular, strong and weak cooperation correlate .50. With trust without cooperation, the correlation with strong cooperation is -.42 and with weak cooperation -.56.

The intercorrelations between the dependent and main independent variables gives already a first insight into the relation between the team innovation climate dimensions and the three types of relations. Participative safety and support for innovation are positively related to strong cooperation relations. Remarkably, interaction frequency does not relate significantly to the three types of relations.

Table 5.2

Means, standard deviations, and correlations among study variables (N = 35)

		M	*SD*	1	2	3	4	5	6	7	8
1	Strong cooperation	0.30	0.18								
2	Weak cooperation	0.08	0.07	0.50**							
3	Trust without cooperation	0.26	0.12	-0.42*	-0.56**						
4	Team size	2.46	0.58	-0.80**	-0.42*	0.04					
5	Team tenure	3.94	3.33	0.28	0.29	-0.37*	-0.05				
6	Institutional context[a]	0.26	0.44	0.41*	0.68**	-0.54**	-0.30	0.41*			
7	Interaction frequency	3.98	0.32	0.05	-0.31	0.17	-0.16	-0.49**	-0.04		
8	Participative safety	3.90	0.35	0.56**	0.29	-0.23	-0.49**	-0.10	0.52**	0.62**	
9	Support for innovation	3.91	0.32	0.44**	0.02	-0.16	-0.39*	-0.37*	0.19	0.62**	0.69**

[a] Reference category: academic teams

*p<.05 **p<.01 ***p<.001

Table 5.3

MANOVA models with strong cooperation, weak cooperation and trust without cooperation as dependent variables (N = 35) (standard errors in parentheses)

	Interaction frequency				Participative safety				Support for innovation			
	Strong	Weak	Trust	Wilks' Lambda	Strong	Weak	Trust	Wilks' Lambda	Strong	Weak	Trust	Wilks' Lambda
Intercept	0.74**	0.46***	0.20	0.41***	0.27	0.35*	0.38	0.63**	0.01	0.41*	0.83*	0.51***
	(0.25)	(0.11)	(0.26)		(0.26)	(0.14)	(0.30)		(0.28)	(0.16)	(0.32)	
Team size	-0.23***	-0.04*	-0.03	0.22***	-0.21***	-0.04*	-0.03	0.26***	-0.20***	-0.04*	-0.05	0.25***
	(0.03)	(0.01)	(0.03)		(0.03)	(0.02)	(0.04)		(0.03)	(0.02)	(0.03)	
Team tenure	0.01+	-0.00	-0.00	0.84	0.02*	-0.00	-0.01	0.78	0.02**	-0.00	-0.01	0.66**
	(0.01)	(0.00)	(0.01)		(0.01)	(0.00)	(0.01)		(0.01)	(0.00)	(0.01)	
Institutional	0.04	0.11***	-0.15**	0.52***	-0.01	0.12***	-0.14*	0.54***	0.00	0.11***	-0.12*	0.55***
context[a]	(0.05)	(0.02)	(0.05)		(0.05)	(0.03)	(0.06)		(0.04)	(0.02)	(0.05)	
Interaction	0.02	-0.08**	0.04	0.73*								
frequency	(0.05)	(0.03)	(0.05)									
Participative					0.12*	-0.05+	0.03	0.73*				
safety					(0.06)	(0.03)	(0.07)					
Support for									0.18**	-0.07+	-0.10	0.6**
innovation									(0.06)	(0.03)	(0.07)	

Note Strong=coinciding cooperation and trust; Weak=cooperation without trust; Trust=trust without cooperation

[a] Reference category: academic teams

+ p<.1 *p<.05 **p<.01 ***p<.001

After these bivariate results, we now turn to the results of the MANOVA models (see Table 5.3) and examine whether the above specified hypothesis are supported. In line with the results from the bivariate analysis, participative safety and support for innovation are positively related to strong cooperation relations. These results are in line with Hypothesis 1. However, no significant relation is found between interaction frequency and strong cooperation relations. Hence, Hypothesis 1 is only partially supported. Even though Hypothesis 2 hypothesized a positive relation between participative safety and interaction frequency and trust without cooperation relations, no significant relations are found regarding these variables. Hypothesis 2 is therefore not supported. Even though at a bivariate level, no relation was found between the team climate dimensions and weak cooperation, there are significant results in the multivariate regression models. More specific, interaction frequency related negatively to weak cooperation. These findings contradict Hypothesis 3, which expected a positive relation between these variables and therefore Hypothesis 3 is rejected.

Furthermore, a negative relation for support for innovation and participative safety with weak cooperation is found. Hypothesis 4 however proposed that these two climate dimensions would not relate significantly to weak cooperation. Hypothesis 4 is therefore rejected. In conclusion, the team climate dimensions are not found to create social control within the team that would stimulate the proportion of weak cooperation. Rather, the team climate dimensions stimulate strong cooperation and lower the level of weak cooperation.

Finally, considering the control variables, the size of the team relates negatively to the proportion of strong and weak cooperation, but is not related to the proportion of trust without cooperation relations. In other words, large teams have proportionally less strong and weak cooperation relations than small teams.

The institutional context is positively significant in all three models of weak cooperation and negatively significant in all three models of trust without cooperation. In other words, an academic context relates positively to trust without cooperation relations, and an industrial context relates positively to weak cooperation relations. The culture within an industrial context thus provides team members with a sense of social control which stimulates the proportion of weak cooperation relations. An academic culture, which stimulated independence, makes that within academic teams a lower proportion of weak cooperation relations is established and a higher proportion of trust without cooperation.

Since tenure is not significant in two of the three MANOVA models (i.e. no significant Wilks' Lambda values), the results of the significant MANOVA model should be interpreted with caution. In the models it is found that teams with a higher median team tenure have higher levels of strong cooperation relations.

5.4 Discussion

This paper has expanded the understanding of the oft-mentioned but empirically understudied multiplexity between trust and cooperation. Around three fourths of the cooperation relations are found to be strong cooperation relations. However, a mean correlation of .30 among the trust and cooperation network points out that there exists still a large proportion of relations that are either trust without cooperation relations or cooperation relations without trust. This paper investigated the underlying contextual factors that influenced the proportion of three types of multiplex configurations: strong cooperation, weak cooperation and trust without cooperation relations.

Furthermore the results of this study widen our understanding about the antecedents of social relations. The existing literature on antecedents of social relations and network structures within an organizational context is in general fragmented (Borgatti & Foster, 2003; Mehra, Kilduff, & Brass, 2001) and is more specifically for the antecedents of intra-team relations limited (Henttonen et al., 2010). However, within organizations, task-work is often organized within a team structure and teamwork is a relevant aspect of task execution. Intra-team relations are seen by managers as relevant social work behavior which can enhance or impede organizational effectiveness. In this light, gaining insights into the antecedents of intra-team relations is valuable and necessary. This study showed that team innovation climate dimensions are contextual antecedents of social relations within the team. In particular, participative safety and support for innovation stimulate the presence of strong cooperation relations and participative safety, support for innovation, and interaction frequency lower the proportion of weak cooperation relations.

In addition, also the institutional culture forms a contextual factor that influences the configuration of single and multiplex relations within teams. Academic teams differ from industrial teams in that the former have less cooperation relations and less weak cooperation relations than the latter. These differences exist because the social expectations and control regarding cooperation, which are absent in academic teams and present in industrial teams.

The results of this study give also further insights into how trust and control relate. In this dissertation we followed the reasoning that there is no trade-off between control and trust, which would imply that when social control in a team is high, trust is low, and vice versa. Rather, this study saw control, brought forward by contextual factors, as a mechanism that facilitates cooperation in relations when trust is absent, thereby not influencing the proportion of trustful cooperation relations. The results of this study support this point of view. More specifically an industrial context is found to bring forward control that facilitates weak cooperation relations. However, teams within an industrial context do not differ from teams within an academic context when it comes to the level of trust. Hence, the presence of social control within the industrial context does not influence the level of trust, but facilitates cooperation in relations where trust is not present.

In the introduction we already referred to the existing trust building interventions which were successful in enhancing trust, but didn't succeed in giving consistent positive effects on performance (Dirks & Ferrin, 2001). The results of this study lead the way to possible alternative interventions focusing on the team innovation climate dimensions. In line with the results, further research could test whether the stimulation of participative safety, support for innovation, and interaction frequency results in a rise in strong cooperation relation and a decrease in weak cooperation relations.

This study is not without limitations. First, the data in this study are cross-sectional, due to which it is problematic to determine causality. Even though due to the design of the study no certainty exist of the direction of this relation, the arguments have a clear theoretical foundation which indicates the explained direction. Second, trust was measured using a single-item. This is an accepted practice within social network research, but may reduce the reliability of the measure. Even though validated psychometric scales are available for trust, a single-item sociometric approach is preferred due to the need to collect data from individuals concerning their interpersonal relations with all other team members (Ferrin et al., 2006; Grosser, Lopez-Kidwell, & Labianca, 2010; Lau & Liden, 2008). A multi-item scale would cause respondent fatigue, especially for large teams, leading to data with questionable face validity. To addresses this problem and in order to gather reliable and valid data, we relied on standard sociometric methods.

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6. CLOSE VERSUS DISTANT NETWORK CONTACTS: DIFFERING SOCIAL CAPITAL RETURNS FOR RESEARCHERS' INNOVATIVE WORK BEHAVIOR.

This study looks at the returns of social capital for researchers' innovative work behavior and argues that different types of contacts give different returns. Three types of contacts, with diverging levels of social and cognitive proximity, are distinguished: team members, internal bridging contacts, and external bridging contacts. The analyses reveal positive social capital returns for innovative work behavior when contacts internal to organizations (team members and internal bridging contacts) give access to instrumental resources and emotional support. External bridging contacts are not found to give social capital returns for innovative work behavior. The findings challenge the generally accepted argument about the positive consequences of bridging contacts for innovative work behavior.

Researchers collaborate extensively and intensively. In the last decades, research collaboration has been stimulated through (governmental) funding policies (Katz & Martin, 1997; Lee & Bozeman, 2005) and the growing awareness by practitioners of the importance of networks for personal success (Baker, 2000). The often complex research tasks executed by researchers require a combination of the skills and knowledge from multiple individuals (Chen, Chang, & Hung, 2008; Lee, Wong, & Chong, 2005). Through their networks, researchers have access to skills and knowledge additional to their own, which create advantages for their performance. When network contacts give access to instrumental resources (e.g. advice, feedback, and criticism) or emotional support that deliver positive returns, the network provides social capital. For example, a researcher may require information on what the current practice is on a matter within the team or he can benefit from extra knowledge on new developments within the research field. Whether accessing this information or knowledge will result in social capital depends upon the outcomes under consideration. This paper assesses the social capital returns for innovative work behavior, that is behavior related to the intentional generation, promotion and implementation of innovative ideas (Janssen, 2000). Idea generation is concerned with the creation of new ideas within a work role, group or organization. Behaviors related to idea promotion are social activities to promote the idea to potential allies to support the idea and to find the necessary information on the standards of the decision makers. Both aligning the idea to the standards and having backers for the ideas enhances the chance of acceptance of the idea. Idea implementation or realization consists out of behaviors related to turning an idea into an application, a prototype, a model, etc. (Janssen, 2000). For researchers, innovative work behavior can be seen as crucial behavior when measuring their performance. We expect that different types of network contacts give access to certain specific social resources, and hence deliver different social capital returns. Distinct features of contact types - in this paper the social and cognitive distance between the individual researcher and his network contact – are argued to result in differences in the usefulness of resources, and thus in different social capital returns.

Social relations are one particular group of contextual factors, next to leadership, work organization and other factors, which have been identified as facilitators or inhibitors of creative and innovative work behavior (De Jong, 2007; Scott & Bruce, 1994; Shalley, Zhou & Oldham, 2004). The literature on determinants of creative and innovative work behavior does not only distinguish contextual factors, but in addition identifies individual level factors such as personality, cognitive ability and job features (De Jong, 2007; Scott & Bruce, 1994; Shalley, Zhou & Oldham, 2004). Individual and contextual level factors are expected to interact in such a way

that a good person-context match results in high levels of creative and innovative performance (Amabile, 1983; Shalley, Zhou & Oldham, 2004).

Within the networks of researchers, three different types of contacts are distinguished: fellow researchers within a team, non-team researchers from within the organization (i.e., from other teams or departments), and researchers from outside the organization (Bozeman & Corley, 2004; Lee & Bozeman, 2005). Because the latter two groups cross team boundaries, both within and outside of the organization, they are referred to as internal and external bridging contacts, respectively. Existing studies have focused on the different returns of team members and bridging contacts for creative and innovative performance (Chen et al., 2008; Cross & Cummings, 2004; Kijkuit & van den Ende, 2007, 2010; Madjar, 2008; Perry-Smith, 2006; Reagans & McEvily, 2003; Reagans & Zuckerman, 2001). Most of these studies (notable exceptions: Madjar, 2008; Perry-Smith, 2006) have concentrated their attention solely on internal bridging contacts, thereby disregarding the contacts from outside the organization. However, as external bridging contacts are from outside of the organization, these contacts are expected to be further distanced (both socially and cognitively) from a researcher than the contacts from within the organization. It is therefore reasonable to anticipate that they will give access to resources which are different from the resources of the contacts within the organization.

By studying three types of contacts together, it is possible to establish the relative importance of each of the types. Hence, it can be examined what are beneficial network compositions for innovative work behavior. As Brass (1984) showed, in his study with regard to influence within the organization, that 'being at the right place' within the network makes all the difference. The right place was shown to depend on the function of the employee within the organization and differed from being central in only the team to being central in the entire organization. In this study, three types of contact (team members, internal bridging contacts and external bridging contacts) are argued to give different social capital returns for innovative work behavior. In keeping with other research (Kijkuit & van den Ende, 2007, 2010; Ohly, Kase, & Skerlavaj, 2010), this study expects different social capital benefits for each of the three aspects of innovative work behavior: idea generation, idea promotion, and idea implementation. For each specific aspect of innovative work behavior, researchers need a specific set of resources.

In the following section, the differences concerning social and cognitive proximity between the three types of contacts are described. The proximity features will imply that each type of contact gives access to a specific set of resources (both instrumental resources and emotional resources). Afterwards, we examine for each of the three aspects of innovative work behavior which

resources are beneficial and through which contacts these resources can be accessed. Thereby, not all types of contacts are expected to be relevant for all aspects of innovative work behavior.

6.1 Instrumental and emotional support resources from the different types of contact

Within the networks of researchers, three relevant types of contacts are differentiated: team members, internal bridging contacts and external bridging contacts. These types of contacts differ in the social (i.e., frequent and direct interaction) and cognitive (i.e., shared norms and shared knowledge base) distance between a focal researcher and the contacts.

The first type of contacts researchers get resources from are fellow team members. In most organizations, research activities are organized in a team setting (Katz, Lazer, Arrow, & Contractor, 2004; Wuchty, Jones, & Uzzi, 2007). In addition, researchers have been found to spend on average half their research time in collaboration with others within their team (Lee & Bozeman, 2005). Thus, for most researchers, teams shape the primary social work environment. In general, team members are therefore socially and cognitively proximate. In line with Coleman's (1988) conceptualization of social capital, social returns are generated by the social and cognitive proximity of team members. The presence of shared norms creates a cooperative environment that promotes trust, where interaction is frequent and direct. Knowledge management insights show that high proximity stimulates the access, transfer, and use of social resources (Hansen, 1999; Obstfeld, 2005; Tortoriello & Krackhardt, 2010). Because of their high social and cognitive proximity, the instrumental and emotional resources of team members are timely (i.e., they are available when the need arises) and are highly appropriable (Madjar, 2008). Furthermore, because research topics within teams tend to be closely related, there is often a homogeneous pool of knowledge and expertise to draw from. This information and knowledge can be both specific - about the research topic - and broad - about the process of innovation within the organization and development possibilities in the research domain (Kijkuit & van den Ende, 2007, 2010; Obstfeld, 2005).

Besides team members, two other types of contacts that bring forward social capital can be identified: internal and external bridging contacts. Internal and external bridging contacts cross respectively team boundaries within and outside of an organization. A key feature that distinguishes between internal and external bridging contacts is the level of social and cognitive proximity. The chance of informally meeting external bridging contacts is smaller than the chance of informally meeting internal bridging contacts, as encounters may take place in a lunchroom, a meeting, the hallway, and so forth. Thus, internal bridging contacts are socially more proximate than external bridging contacts. Furthermore, the cognitive proximity with internal bridging

contacts comes from the overarching corporate culture and common goals (Inkpen & Tsang, 2005). Relations with external bridging contacts are subject to differences in corporate culture and common goals. Internal bridging contacts are thus socially and cognitively closer than external bridging contacts. Both Granovetter's (1973) seminal work on weak ties and Burt's (2000, 2004) structural holes theory posit that bridging contacts bring novel perspectives and unique knowledge. In addition, previous research has shown that closeness facilitates the transfer of knowledge and information (Hansen, 1999; Lee et al., 2005; Obstfeld, 2005; Reagans & McEvily, 2003; Tortoriello & Krackhardt, 2010). Especially the access to complex or specialized knowledge will be impeded when contacts are socially and cognitively too distant. Therefore, more complex or specialized novel knowledge and information will be accessed through contacts with the closer internal bridging contacts and external bridging contacts will deliver more general unique and novel knowledge and information. The emotional support of bridging contacts is, in comparison to the emotional support of team members, less timely. The emotional support from bridging contacts informs researchers that their ideas are valued and appreciated within the larger organization or research field (Madjar, 2008).

6.2 Instrumental social capital returns for innovative work behavior

Individual level innovation starts with the generation of ideas. Existing research has shown the need of being exposed to diverging thoughts, diverse and novel perspectives and unique information for the generating of ideas in general and creativity more specific (Burt, 2004; Perry-Smith, 2006; Perry-Smith & Shalley, 2003). In terms of network contacts, this means that it is beneficial to be connected to external bridging contacts, which bring forward these essential idea generating stimuli. In contrast, the instrumental resources of team members and internal bridging contacts are not diverse, novel and unique enough to stimulate the generation of ideas. Therefore, this study hypothesizes that accessing instrumental resources from external bridging contacts is beneficial for idea generation.

> *Hypothesis 1*: The access to instrumental resources from external bridging contacts is positively related to idea generation.

After generating ideas, researchers continue to the promotion of these ideas. At this stage, a consensus about the value, necessity and utility of the idea needs to be created for easier acceptance during the decision making process concerning the future of the idea (i.e. continue or stop the idea). Gaining a positive evaluation of the idea is facilitated by aligning the idea to meet the standards of decision makers and supporters. Here, network contacts can deliver the necessary knowledge and information on the standards of both decision makers and supporters

and help by building a coalition and exerting influence on decision makers in favor of the idea (Kijkuit & van den Ende, 2007, 2010). First, instrumental resources of team members are beneficial for idea promotion. As members of a coalition supporting the idea are found more easily within a homogeneous context (Kijkuit & van den Ende, 2007, 2010), team members are most readily available to back the idea. In addition, team members can give access to information on the objectives and criteria of the supporters and decision makers. Second, the instrumental resources from internal bridging contacts, are expected to give positive returns for idea promotion as well. Internal bridging contacts provide insight into the innovation process, objectives and criteria within an organization. This information is again valuable for aligning the idea to the standards of decision makers. Finally, external bridging contacts are not expected to hold information and knowledge about the intra-organizational innovation process. These contacts are therefore not expected to be relevant for idea promotion. Thus, this study hypothesizes that the instrumental resources coming from team members and internal bridging contacts will relate positively to idea promotion.

> *Hypothesis 2a*: The access to instrumental resources from team members is positively related to idea promotion.
>
> *Hypothesis 2b*: The access to instrumental resources from internal bridging contacts is positively related to idea promotion.

Finally, the idea needs to be realized or implemented. Idea implementation requires researchers to find opportunities to implement ideas and to develop applications. Comparable to idea generation, for finding implementation opportunities it is beneficial to be exposed to diverse and novel knowledge and information. Knowledge and information concerning the specific topic and the implementation process in a specific field is helpful for developing applications. Team members' instrumental resources are valuable in developing applications for implementation, as they give access to information concerning the innovation process and the research field in which the application will be introduced. When seeking implementation opportunities, researchers benefit from the instrumental resources that come from a larger external bridging network. The latter allows them to scan the environment for those opportunities (Burt, 2004; Kijkuit & van den Ende, 2007, 2010; Perry-Smith, 2006). The instrumental resources accessed through internal bridging contacts are expected to stimulate neither the finding of implementation opportunities (resources are not diverse and novel enough), nor the development of applications (resources are not specific enough). Therefore, this study hypothesizes that the instrumental resources coming from team members and external bridging contacts will relate positively to idea implementation.

Hypothesis 3a: The access to instrumental resources from team members is positively related to idea implementation.

Hypothesis 3b: The access to instrumental resources from external bridging contacts is positively related to idea implementation.

6.3 Emotional support for innovative work behavior

For all three aspects of innovative work behavior, researchers benefit from emotional support. When occupied with the generation, promotion, and implementation of ideas, researchers may experience problems, risks, tensions, and stress. Emotional support resources allow researchers to counter negative feelings related to innovative work behavior and generally encourage them to innovate and take risks (Anderson, De Dreu, & Nijstad, 2004; Janssen, Van de Vliert, & West, 2004; Madjar, 2008; Oh, Labianca, & Chung, 2006). Team members are most likely to be present when emotional support is needed. Furthermore, they understand the internal innovation process and can offer emotional support that is appropriable. Therefore, the emotional support of team members is expected to have a positive influence on innovative work behavior. The influence of emotional support from bridging contacts for innovative work behavior is expected to be limited, as the support is less timely and more general. Hence, this study hypothesizes that emotional support from team members will be positively related to all three aspects of innovative work behavior.

Hypothesis 4a: The access to emotional support from team members is positively related to idea generation.

Hypothesis 4b: The access to emotional support from team members is positively related to idea promotion.

Hypothesis 4c: The access to emotional support from team members is positively related to idea implementation.

6.4 Method

Research setting and sample

Data were collected between March 2011 and July 2012 as part of a research project on social capital and innovation. The respondents are members of research teams within industrial organizations or universities in Flanders. All industrial teams are embedded in research-intensive industries—more specifically, IT and technology, pharmaceuticals, chemistry, and biotechnology.

The academic teams reflect the academic counterpart of these industries. During a personal interview, the head of the team provided individual scores for each team member's innovative work behavior. The data from the team members was gathered by means of a paper questionnaire. These questionnaires were delivered in print form to the heads for further distribution. In order to allow for the gathering of network data, the questionnaires were not anonymous. After completion, the team members returned the questionnaires in individually sealed envelopes to maintain confidentiality. In total, 416 questionnaires were distributed among the members of 34 teams, of which 341 were completed and returned, resulting in an overall response rate of 81.9%. Nine industrial teams, with a total of 66 members (team heads excluded), and 25 academic teams, with 275 members (team heads excluded), participated. Of these participants, 43.3% of the academic researchers and 24.2% of the industrial researchers are female. The average age is 29.4 years (*SD*= 6.2) for academic researchers and 37.3 years (*SD* = 9.3) for industrial researchers. The modal education level for academic researchers are an academic master degree (*N* = 171 respondents), followed by a doctoral degree (*N* = 82). For industrial researchers, the most frequently reported highest education level is a doctoral degree (*N* = 22), followed by an academic master degree (*N* = 17).

Measurements

Innovative work behavior. Janssen's (2000) multi-dimensional scale, based on the research of Scott and Bruce (1994), was used to measure the innovative work behavior of individuals. This nine-item scale measures the relevant behavioral actions related to three distinct aspects: idea generation, idea promotion, and idea realization. The team leaders rated how often respondents performed the nine behavioral actions. The response format ranged from 1 (never) to 7 (always). The responses to the individual items were averaged for each aspect of innovative work behavior, creating a measure for idea generation, idea promotion, and idea implementation. Even though the innovative work behavior scale was developed and validated as a multi-dimensional scale, most studies up-until-now have used the scale as a unidimensional scale. After executing an explorative factor analysis (EFA in MPLUS version 6), the multidimensional structure proposed by Janssen (2000) is confirmed for our data. First, the model fits from a one and three factor model with EFA (oblique promax rotation) are as follows: the one factor model has a RMSEA estimate of 0.20, compared to an estimate of 0.07 for the three factor model. In the literature, a RMSEA of less than 0.08 is taken as an adequate fit between the specified model and the data. Therefore, a three factor model is to be preferred over a one factor model. The correlations

between the three aspects are between 0.70 and 0.75. Cronbach's alpha is 0.92 for idea generation, 0.90 for idea promotion, and 0.87 for idea implementation

Instrumental resources and emotional support. The instrumental resources and emotional support variables are operationalized as volume measures (Lin, 1999), so that the variables represent the accessible amount of respectively instrumental resources and emotional support per type of contact. In general, volume measures for resources are computed by multiplying the number of accessible resources with the number of contacts. The initial data was gathered by the following procedure. First, data was gathered on the number of resources that respondents have access to. Respondents received a list of three instrumental resources (i.e., detailed advice, feedback, and honest criticism) and three emotional support resources (i.e., discuss difficulties, discuss conflict, and gain confidence). For each resource, the respondents were asked to indicate through which types of contacts they accessed the resource. The options were team members, researchers from within the larger organization (internal bridging contacts), researchers from external organizations (external bridging contacts). Regarding the external bridging contacts, two types were distinguished based on whether the contacts came from a similar or different type of organizations when considering their institutional context (i.e. industrial or academic research organizations). The contacts from a similar type of organization are for the respondents from the academic teams academic researchers from different universities and for the respondents from the industrial teams industrial researchers of different companies. The contacts from a different type of organization are for the respondents from the academic teams industrial researchers and for the respondents from the industrial teams academic researchers. Respondents could also indicate that they did not access the resource. From these data, four variables were created by summing for each of the four types of contact the number of instrumental resources the respondent accessed and four variables were created by summing for each of the four types of contact the number of emotional support resources the respondent accessed. Second, the respondents were asked to indicate by approximation how many people of each type of contact (as defined above) they had work-related contacts with. This results in four variables indicating the number of contacts per type. Thus, per type of contact, volume measures for resources are computed with the following formula: (Number of accessible resources)*(Number of contacts). More specific, four volume measures for instrumental resources were computed by multiplying the number of instrumental resources per type of contact and the number of contacts per type. Analogous, four volume measures for emotional support resources were computed by multiplying the number of emotional support resources per type of contact and the number of contacts per type.

When the number of contacts increases, the opportunity costs for maintaining all relations are expected to grow as the marginal returns diminish. Opportunity costs related to maintaining contact, sharing information and knowledge, giving support, and so forth, increase when the number of contacts increases. Additionally, we expect that with the increase in the number of contacts, the increase in the number of unique resources diminishes, leading to diminishing marginal returns from additional contacts. Thus, we expect that the positive effect of an additional contact will decrease as the number of contacts increases (Hansen, Podolny, & Pfeffer, 1999; Van der Gaag & Snijders, 2005). To address this non-linear relation between the volume of resources and their returns, a log transformation is executed on the variables (specified above) related to the volume of resources.

Control variables. Several variables were entered in the analysis as control variables at the individual level. Gender (0 = female, 1 = male) and age (in years) were added to the analyses as sociodemographic characteristics, in order to consider their possible interference with the dependent and independent variables. Furthermore, when considering innovative work behavior, human capital is an important factor in explaining individual differences. Since this study focuses on social, rather than on human capital, we added a control variable for the latter. Previous research shows that the human capital variable which is most strongly related to innovative performance is educational level. The higher the educational level is, the higher the innovative performance will be (Lee et al., 2005). Therefore, the educational level of the respondent was entered as control variable in the analysis.

In addition, due to the composition of the sample - which includes both academic and industrial research teams - a control variable was added to indicate whether the respondent is a member of an academic research team or an industrial research team. As the number of industrial research teams is small, we were not able to conduct the analyses for each of the types separately.

6.5 Descriptive findings – networks of researchers

Before examining the differential social capital returns of types of contacts for researchers' innovative work behavior, this section addresses the composition of the networks of researchers and the embedded resources. These descriptive findings show the heterogeneous composition of researchers' networks and the access researchers have to instrumental resources and emotional support. Descriptive information concerning the size of the networks is found in Table 6.1. In this study, the respondents had contact with on average 10 team members (*SD* = 6.50; median = 8). For the internal bridging contacts, the mean was 11 (*SD* = 18.65; median = 5). In general, external bridging contacts are less present within the networks of researchers. Researchers have

on average seven relations (*SD* = 14.62; median = 3) with external bridging contacts affiliated to a same type of organization (i.e., relations between academics of different universities or between industrial researchers of different companies) and three relations (*SD* = 7.05; median = 1) with external bridging contacts from a different type of organization. The high standard deviation in comparison to the average for the internal and external bridging contacts shows a great disparity between the number of internal and external bridging contacts among the respondents.

Table 6.1

Number of contacts per type of contact

	Mean	*SD*	Median
Team members	9.91	6.50	8
Internal bridging contacts	10.74	18.65	5
External bridging contacts - same type of organization	7.05	14.62	3
External bridging contacts - different type of organization	3.24	7.05	1

Table 6.2 is a cross tabulation of the number of instrumental resources and the number of emotional support resources per type of contact. For the resources accessed through team members, a large majority (73%) of researchers accesses all three instrumental resources queried. Emotional support is accessed less frequently from team members, with around 44% accessing three emotional support resources and another 27% accessing two. Thirty nine percent of the respondent access both the three instrumental and the three emotional support resources. In contrast, 3% of the respondents accesses neither instrumental nor emotional support through team members.

Table 6.2

Cross tabulation for the number of instrumental resources and emotional support per type of contact (in % of total)

Team members

		Number of instrumental resources				
		0	1	2	3	Total
Number of emotional support resources	0	2.6	1.5	1.2	2.6	7.9
	1	0.3	2.1	7.6	11.5	21.5
	2	0.3	1.5	5.0	20.0	26.8
	3	0.0	0.3	4.4	39.1	43.8
	Total	3.2	5.3	18.2	73.2	100.0

Internal bridging contacts

		Number of instrumental resources				
		0	1	2	3	Total
Number of emotional support resources	0	32.1	10.5	6.6	1.5	50.8
	1	4.8	8.4	6.6	4.8	24.6
	2	1.8	3.6	4.5	5.1	15.0
	3	0.9	0.9	3.9	3.9	9.6
	Total	39.6	23.4	21.6	15.3	100.0

External bridging contacts – same type of organization

		Number of instrumental resources				
		0	1	2	3	Total
Number of emotional support resources	0	56.2	13.5	6.2	0.9	76.8
	1	3.5	4.4	3.2	1.8	12.9
	2	0.9	1.2	2.1	2.4	6.5
	3	0.3	0.3	1.5	1.8	3.8
	Total	60.9	19.4	12.9	6.8	100.0

External bridging contacts – different type of organization

		Number of instrumental resources				
		0	1	2	3	Total
Number of emotional support resources	0	75.3	8.5	2.1	0.3	86.2
	1	4.1	2.1	2.9	2.4	11.5
	2	0.3	0.0	0.6	0.3	1.2
	3	0.0	0.0	0.6	0.6	1.2
	Total	79.7	10.6	6.2	3.5	100.0

Through relations with internal bridging contacts, 60% of the respondents access one or more instrumental resources. Half of the respondents do not access emotional support through this type of contacts. Thirty three percent of the respondents indicate that they do not have access to instrumental and emotional support resources from internal bridging contacts.

The amount of instrumental and emotional support resources accessed through contacts with external bridging contacts is much lower in comparison to the team and internal bridging contacts. Fifty six percent of the respondents indicate to not access any instrumental or emotional support resources from external bridging contacts from a similar type of organization. For external bridging contacts from a different type of organization, three fourth of the respondents indicate to not access neither instrumental nor emotional support resources.

In short, the networks of researchers in this study have been found to consist mainly of contacts from within the organization they work for. The median researcher has 13 contacts from within its own organization, from which a majority from within his own research team. This network of contacts from within the organization is complemented by a much smaller group of organization-external contacts. However, the spread of the number of contacts (see standard deviations) and the amount of instrumental resources and emotional support accessed through non-team contacts indicate that the networks of researchers differ in composition. In order to address the question of whether this network composition influences the innovative potential of a researcher, we examine in the next section how these different types of network contacts, with their instrumental resources and emotional support, associate to higher or lower levels of innovative work behavior.

6.6 Results - social capital for innovative work behavior

Table 6.3 shows the results of the analyses concerning the influence of instrumental resources and emotional support from different types of contacts on each of the three aspects of innovative work behavior. As the data are hierarchically nested (i.e., a researcher is nested within a research team), multilevel analyses are used as the appropriate method to model dependencies between focal variables. Two separate multilevel regression models are analyzed for each of the three aspects of innovative work behavior. The two models differ from each other: Model 1 includes all variables concerning the volume of instrumental resources, and Model 2 includes all variables concerning the volume of emotional support. Both Model 1 and Model 2 contain all control variables referred to above.

Table 6.3

Multilevel regression models for idea generation, idea promotion and idea implementation (standard errors are in parentheses)

	Idea generation		Idea promotion		Idea implementation	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Intercept	4.27***	4.05***	3.57***	3.66***	3.03***	3.05***
	(0.48)	(0.46)	(0.51)	(0.49)	(0.50)	(0.48)
Instrumental resources						
- team members	0.01		0.15*		0.17*	
	(0.07)		(0.07)		(0.07)	
- internal bridging	0.09*		0.12**		0.12**	
contacts	(0.04)		(0.04)		(0.04)	
- external bridging	-0.07		-0.01		-0.09	
contacts same	(0.05)		(0.05)		(0.05)	
- external bridging	0.07		0.01		0.11	
contacts different	(0.07)		(0.08)		(0.07)	
Emotional support						
- team members		0.09		0.15*		0.15**
		(0.06)		(0.06)		(0.06)
- internal bridging		0.05		0.04		0.11*
contacts		(0.04)		(0.05)		(0.04)
- external bridging		-0.03		0.05		-0.11
contacts same		(0.06)		(0.06)		(0.06)
- external bridging		-0.07		-0.03		0.01
contacts different		(0.09)		(0.09)		(0.09)
Gender: male	0.39**	0.42**	0.15	0.18	0.11	0.17
	(0.13)	(0.13)	(0.13)	(0.49)	(0.13)	(0.03)
Age	0.00	0.00	0.00	0.00	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Professional master's[a]	-0.21	-0.13	0.07	0.22	-0.19	-0.10
	(0.35)	(0.35)	(0.36)	(0.36)	(0.34)	(0.34)
Academic master's[a]	0.48	0.52*	0.69**	0.76**	0.31	0.37
	(0.25)	(0.26)	(0.26)	(0.26)	(0.24)	(0.24)
Doctorate[a]	1.05***	1.15***	1.22***	1.32***	0.88***	0.98***
	(0.25)	(0.26)	(0.26)	(0.26)	(0.24)	(0.25)
Type of team:	-0.05	0.03	-0.24	-0.24	0.52	0.52
R&D	(0.29)	(0.29)	(0.42)	(0.41)	(0.51)	(0.50)
χ^2 difference[b]	47.91***	47.12***	51.00***	45.83***	57.84***	55.23***
	(df = 10)	(df = 10)	(df = 10)	(df = 10)	(df = 10)	(df = 10)
R^2 individual level	0.16	0.15	0.17	0.14	0.24	0.28
R^2 team level	-0.12	-0.08	0.00	0.05	0.07	0.10
N	313	314	313	314	312	313
ICC	0.16	0.16	0.39	0.39	0.52	0.54

Note. R^2 values are calculated according to the Raudenbush & Bryk (2002) formula (Hox, 2010). This method is known to sometimes result in negative explained variance values. In the models for idea generation, the second level R^2 values are indeed negative. The alternative method for calculating R^2 for multilevel models, using the adapted formula of Snijders and Bosker (1994) gave for the two models for idea generation also negative values for the second level. The R^2 at

level two is for model 1 of idea generation -0.0005 and for model 2 of idea generation -0.02. Since this value is smaller than -0.05, the cause of this negative value to occur is random chance (Recchia, 2010).
[a] Reference category: bachelor degree or lower.
[b] Compared with intercept-only model.
ICC=Intraclass correlation coefficient
*$p < .05$ **$p < .01$ ***$p < .001$

Hypothesis 1 proposes a positive relation between the access to instrumental resources from external bridging contacts and idea generation. In model 1 for idea generation no significant effect is found from the instrumental resources from external bridging contacts for idea generation. Hence, Hypothesis 1 is rejected.

Hypothesis 2a and 2b claim that the access to instrumental resources from respectively team members and internal bridging contacts relate positively to idea promotion. The results in model 1 for idea promotion indicate that the instrumental resources from both team members and internal bridging contacts associate significantly to idea promotion. Hypothesis 2a and 2b are thus accepted.

Hypothesis 3a and 3b state that the access to instrumental resources from respectively team members and external bridging contacts are positively related with idea implementation. The model 1 for idea implementation shows a significantly positive relation between team members and idea implementation. However, no significant association is found for the instrumental resources from external bridging contacts. Thus, Hypothesis 3a is accepted and Hypothesis 3b is rejected.

These findings confirm the expected social capital benefits from the instrumental resources from team members and internal bridging contacts for innovative work behavior. Moreover, internal bridging contacts have been found to contribute to idea generation and idea implementation. Contrary to our expectations, the instrumental resources of external bridging contacts did not deliver any social capital returns.

Hypothesis 4a, 4b and 4c concern the social capital returns of emotional support for innovative work behavior. The results for these hypotheses are found in the models 2 of Table 6.3. Both idea promotion and idea implementation relate positive and significant to the emotional support from team members. However, no significant relationship exists between the emotional support from team members and idea generation. Therefore, Hypothesis 4a is rejected and Hypothesis 4b and 4c are supported.

Thus, emotional support is found to contribute to idea promotion and idea implementation, but not to idea generation. For idea promotion, the emotional support from team members is shown to be beneficial and for idea implementation, in turn, the emotional support from team members and internal bridging contacts contributes.

Considering the individual level control variables, only a small number of effects have been found for the innovative work behavior aspects. Being a male researcher is only significantly and positively related to idea generation. Age is not associated with any of the tasks of innovative work behavior. Regarding educational level, doctorate holders score significantly higher on the innovative work behavior tasks than researchers with only bachelor diploma or less. For idea promotion, also an academic master diploma has been found to have a positive and significant effect. This confirms the importance of human capital, as measured by educational level, for individual-level innovation.

Due to the heterogeneity in the sample – both academic and industrial research teams are included – we examined possible differences in results by adding the type of team as a variable and examining all cross-level interactions with type of team for all main independent variables in all models. For all models, the direct effect of type of team was insignificant (see all models Table 6.3), meaning that the innovative work behavior of researchers – as measured by the three aspects – does not differ between academic and industrial teams. Furthermore, the cross-level interactions were all found non-significant. Hence, no differences exist between researchers embedded within academic teams versus industrial teams when considering the before specified hypothesis.

6.7 Discussion

The study aimed to further develop the understanding of how researchers' social capital relates to their innovative work behavior. The findings of this study confirm that there are differential social capital returns of team members, internal bridging contacts, and external bridging contacts. Nonetheless, the results of this study also lead to several points of discussion. Most interestingly, external bridging contacts (both from similar and different organizations) are not only found, as hypothesized, to be too distant to give access to emotional support, these contacts are also found to be too distant to deliver instrumental resources that are beneficial for innovative work behavior. This contradicts the theory of Burt (2004) and Granovetter (1973), which points to the positive returns of bridging contacts by presenting heterogeneous viewpoints and information. However, they do not theorize possible difficulties in utilizing the accessed resources. These difficulties have been studied in more depth within knowledge management. Several studies have

shown the importance of proximity for the access, transfer, and use of social resources (Hansen, 1999; Obstfeld, 2005; Tortoriello & Krackhardt, 2010). More specific, the ease of getting returns on social resources from contacts depends on the level of social and cognitive proximity that is present. In the case of external bridging contacts, the access, transfer, and/or use of social resources is impeded due to the distance between the individual and its contact. In line with the studies of Hansen (1999) and Tortoriello and Krackhardt (2010), our results further problematize the generally accepted theoretical argument that bridging contacts bring about social resources that enhance the innovative performance of researchers in particular and knowledge workers more in general.

Although the effects for the instrumental resources from external bridging contacts are not significant (for the idea implementation model, they are almost significant), there seems to be a difference between contacts from similar and different organizations. The coefficients for instrumental resources from external contacts from similar organizations have a negative sign, while the coefficients for instrumental resources from external contacts from different organizations have a positive sign. This could perhaps point out that while the distance between an individual and his external contacts hampers the transfer and use of the instrumental resources, the resources from contacts from different organizations bring forward relevant heterogeneous viewpoints and information, while the contacts from similar organizations do not. Hence, instrumental resources from external contacts from different organization may be valuable, despite the difficulties occurred with transferring them. However, since the results are not significant in this study, future research should examine this further and look for particular situations in which the instrumental resources external contacts from different organizations enhance performance.

Further, this study addressed the goal specificity of social capital by examining the outcomes for three separate aspects of innovative work behavior: idea generation, idea promotion, and idea implementation. Even though these three tasks correlated highly, different arguments are made on how they relate to social capital. The results show that the social resources contribute differently to each of the three aspects of innovative work behavior. For example, the instrumental resources and emotional support from team members does not contribute significantly to idea generation, in contrast to idea promotion and idea implementation. Furthermore, the emotional support from internal bridging contacts does contribute significantly to idea implementation, but not to the other two aspects of innovative work behavior. These differences reflect the different necessity for each of the aspect of innovative work behavior of

instrumental and emotional resources and is in line with the view that social capital is goal specific (Hansen, Podolny, & Pfeffer, 2001). Thus, analyzing the relation between social resources and an overall measure of innovative work behavior may fail to yield more detailed insights into the differential contribution of social resources to each aspect of innovative work behavior separately. As the social capital returns differ between the aspects of innovative work behavior, future research needs to examine the social returns for innovative work behavior for each aspect separately, taking the goal specificity of social resources and social capital into consideration.

This study has practical implications concerning the benefits, in the form of social capital, network contacts bring forward for researchers. Researchers have been found to have most contacts within their own organization. In addition, it were the instrumental resources and emotional support of these contacts that resulted in positive outcomes for innovative work behavior. Team members have been found to give access to useful and valuable instrumental resources, as well as emotional support. Contacts from the wider organization are important for their instrumental resources and to a more limited extent also for their emotional support. Thus, organizations that want to enhance their innovative potential should stimulate an open and safe climate for sharing instrumental resources and receiving emotional support. Furthermore, even though this study does not find positive returns from contacts outside of the organization, we do not suggest that all relations with bridging contacts should be discontinued. Existing research has found benefits of inter-organizational relations for teams, organizations and research fields.

This study is not without limitations. First, the sample includes only researchers within research-intensive industries and their academic counterparts. The findings are restricted to this group of industries. For researchers within less research-intensive industries (e.g., food industry, textiles, and transport industry) and academic fields such as the social sciences, a different rationale for making individual-level interorganizational relations can be expected. Only further research on this other group of researchers can provide insight into the similarity and differences of the processes at hand. Second, the data do not contain information on the exact number of contacts for each resource or on whether the same relation provides more than one resource. Collecting more detailed data for each relation regarding the strength or intensity of the relation and the exact resources shared would lead to more fine-grained results. However, the collection of such data can be demanding for the respondents involved. Mapping one's personal network in such detail requires a substantial investment of time and is cognitively demanding, leading to possible recollection biases. Finally, this study shows that there exist social capital returns for innovative

performance. However, due to the cross-sectional data, the proposed causality is not tested and therefore, the results should be interpreted with caution.

To conclude, this study shows that social capital returns for innovative work behavior are different for the distinct types of contacts that provides social resources. Most importantly, this study contributes to the research on the returns of bridging contacts. By separating different types of bridging contacts, the returns of bridging contacts for innovative work behavior were examined. The findings point out that contrary to the resources of internal bridging contacts, those of the external bridging contacts do not bring about higher levels of innovative work behavior.

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7. GENERAL DISCUSSION AND CONCLUSION

This dissertation focused on the social embeddedness of researchers within their network of work-related contacts and dealt with antecedents and outcomes of this embeddedness. Considering the outcomes of these contacts, it was already established in former research that intra-team relations deliver social capital benefits for team innovative performance (Henttonen, 2010; Reagans & Zuckerman, 2001). Even though the existing studies give valuable insight into which intra-team relations and structures stimulate team innovative performance, they fail to give concrete proposals into how these beneficial team relations and structures can be achieved. A first objective of this dissertation was therefore to examine which factors influence the presence and structure of these intra-team relations. Besides investigating antecedents of intra-team relations, this dissertation also studied individual level outcomes of the embeddedness of researchers within their work-related network. In particular, the second objective of this dissertation was to examine the relative importance of intra-team relations, when considering that researchers also have external contacts, for individual level innovative performance. This chapter provides a summary of the empirical studies, followed by a discussion of these results in the light of the research questions. Afterwards, the practical implications and limitations of this dissertation are discussed, followed with a brief introduction of topics for further research.

7.1 Summary of the empirical studies

This section recapitulates briefly the main ideas, expectations and findings of each of the empirical studies incorporated in this dissertation.

7.1.1 Study 1

The first empirical study, in Chapter 3, studied achievement goals as individual level antecedents of ego-network structures. Achievement goals are an psychological construct giving individuals the motivation for behavior in achievement situations. In other words, achievement goals make that researchers set certain behaviors at work and is thus seen as a factor that captures agency in the formation of intra-team relations.

This study focused on two previously studied achievement goals: 1) a learning goal orientation – that is to develop one's abilities and to acquire new skills – and 2) a performance goal orientation – that is to demonstrate one's abilities and to gain positive evaluations or favorable judgments about one's abilities. It was argued that the influence of an individual's achievement goals on his or her social relations is context specific and thus should not be studied solely within an experimental context. Thus, in this study, the relationship between achievement goals and social

relations is examined in real-world work team settings. The effects of achievement goals were studied by focusing on two characteristics of the immediate network environment of individuals (i.e. degree and constraint) for instrumental, positive affective and negative relations. Since a learning goal orientation motivates individuals towards interacting with others, triggers social acceptable behaviors and relates to pro-active, independent individuals (Poortvliet & Darnon, 2010), a high learning goal orientation was expected to be related to a high number of instrumental and positive affective relations, a low number of negative affective relations, and low constrained networks. In contrast, a performance goal orientation restrains individuals from interacting, creates mal-adaptive behaviors and relates to individuals who prefer security and stability (Janssen & Van Yperen, 2004; Poortvliet, Anseel, Janssen, Van Yperen, & Van de Vliert, 2012). Therefore, individuals with a high performance goal orientation were expected to have a low number of instrumental and positive affective relations, a high number of negative affective relations and high constrained networks.

The results showed that a high learning goal orientation related to more trust by ego and less constrained networks. However, alters trust individuals with a high learning goal orientation less, and distrust them more. A performance goal orientation was related to neither distrust nor trust. The expected mal-adaptive behavior related to a performance goal orientation was not found to arise within a team context. In conclusion, one achievement goal, a learning goal orientation, is found to motivate individuals into social interactions and shaping their networks. Hence, a learning goal orientation is a factor that captures the agency of individuals within a team context. In contrast, a performance goal orientation did not relate to the expected behaviors and is found to be constrained by the team context.

7.1.2 Study 2

The second empirical study, in Chapter 4, addressed the congruency between team innovation climate dimensions and team network structures. More specific, the five dimensions of team innovation climate (i.e. interaction frequency, participative safety, support for innovation, task orientation, and vision) were examined in relation to both closure and fragmentation network structures of six networks (i.e. cooperation, advice giving, friendship, dissonant relations, trust, and distrust). Starting off from the premise that innovative performance relies on teamwork and that a team climate is a social cognitive construction of the in-role work behaviors (Anderson & West, 1998; Zohar & Luria, 2004), network structures and team innovation climate were expected to be congruent. Since team innovation climate dimensions stimulate instrumental and/or positive affective relations, they were argued to relate to closed instrumental and/or positive

affective network structures and sparse and highly fragmented negative affective network structures.

Two dimensions of team innovation climate (particularly participative safety and support for innovation) were found to be antecedents of closed networks regarding instrumental and positive affective relations. Interaction frequency related to sparse and fragmented negative affective networks and closed friendship networks. The other dimensions of team innovation climate (vision and task orientation) did not relate to team network structures. Hence, this empirical study showed that three dimensions of team innovation climate are indeed antecedents of intra-team relations and structures. In addition, the findings showed both overlap and complementarity between the team innovation climate dimensions and team network structures. The study's major contribution was pointing out the possibilities towards integrating the team innovation climate literature with the team network literature. Even though the distinct perspectives have already offered valuable insights, integrating these two literatures is expected to further advance our understanding of how the team context can be beneficial for innovative team performance.

7.1.3 Study 3

The third empirical study, in Chapter 5, examined the multiplexity between trust and cooperation relations. Within the trust literature, interpersonal trust is argued to be a network-level antecedent of cooperation (Dirks & Ferrin, 2001). However, interventions designed to stimulate trust were not successful in increasing the level of cooperation. In this study, it was argued that whether trust stimulates cooperation is dependent upon contextual factors which provide social expectations and social control related to cooperation. In particular, the influence of three dimensions of team innovation climate (participative safety, interaction frequency, support for innovation) on the proportion of strong cooperation (i.e. coinciding trust and cooperation), weak cooperation (i.e. cooperation without trust) and trust-only (i.e. trust without cooperation) relations within a team network was studied.

Participative safety, interaction frequency, and support for innovation were argued to stimulate trust and/or cooperation within teams. Therefore, the three dimensions were expected to stimulate the proportion of strong cooperation relations within the team. Participative safety and interaction frequency were expected to increase the proportion of trust-only relations in cases when cooperation is not relevant. For weak cooperation relations, the role of trust needs to be taken over by social control mechanisms. Interaction frequency was expected to be a contextual

factor that brings forward relevant social control mechanisms, and thus stimulates weak cooperation relations.

The findings of this study showed that the three dimensions of team innovation climate were found to be relevant contextual factors influencing the configuration of multiplex trust-cooperation relations within teams and should thus be seen as antecedents of intra-team multiplex relationships. In particular, participative safety and support for innovation relate to a higher proportion of strong cooperation relations and participative safety, support for innovation, and interaction frequency all relate to a lower proportion of weak cooperation relations. The results of this study also showed that even though a large proportion of the cooperation relations are trustful, the correlations between the trust and cooperation networks are low. Up to a certain extent, trust can thus be seen as an antecedent of cooperation, in the way that trust is often needed for a cooperation relation to be established. However, trust is in far more relations present than only cooperation relations and cooperation relation can also exist without trust, i.e. when social control mechanisms take over the role of interpersonal trust in securing cooperation relations. Trust is thus only in particular contexts an antecedent of cooperation relations. Furthermore, at the institutional level the academic and industrial culture are found to be antecedents of social relational structures. In particular, academic teams establish less cooperation relations and a lower number of weak cooperation relations than industrial teams. Even though the literature on the cultural differences between the academic and industrial context was rather ideal-typical and dated, the university and the industry are still found to be two different settings when it comes to teamwork.

7.1.4 Study 4

The last empirical study, in Chapter 6, focused on the outcomes of the social relations that individual researchers hold. Since theory proposes that social capital is goal-specific, the outcome benefits were examined in relation to three behaviors related to innovative work behavior: idea generation, idea promotion and idea implementation. The benefits of instrumental and emotional resources that researchers access through three types of contacts, i.e. team contacts, internal bridging contacts (within organization but outside of the team) and external bridging contacts (from within the research field) were examined for each of the behaviors.

Based on the knowledge management theory and social capital theory, it was hypothesized that all three types of contacts give access to instrumental resources relevant for one or more of the behaviors. Furthermore, through contact with team members researchers were expected to access

the necessary emotional support for all innovative work behavior aspects. The internal and external bridging contacts were expected to be too distant from the researcher to give emotional support.

The results of this study showed that team members play a crucial role in giving access to necessary resources (both instrumental and emotional) for idea promotion and implementation, but not for idea generation. The instrumental resources of internal bridging contacts stimulated all three aspects of innovative work behavior. For emotional support, the internal bridging contacts were, as expected, too distant. Remarkably, external bridging contacts were not only too distant to give access to emotional support, but also instrumental resources. This contradicts the well-known theories of Burt and Granovetter, but is in line with the knowledge management theory, which showed already the importance of proximity for the access, transfer and use of knowledge.

In short, this study advanced the social capital literature by showing that social resources contribute differently to each of the three aspects of innovative work behavior, and that the returns are different for distinct types of contacts that provide social resources. In addition, an important contribution is made to the research on returns of bridging contacts. Two distinct types of bridging contacts were identified, one within and one outside of the organization. The external bridging contacts, contrary to the internal bridging contacts, were not found to give access to resources that bring about higher levels of innovative work behavior.

7.2 Discussion

This dissertation had two main research questions. The first research question addressed antecedents of the intra-team relations and team social structures, while the second question concerned the individual level benefits these team relations bring, given that researchers also have contacts with researchers outside of their team. The results from the empirical studies in this dissertation provide answers to both of these questions.

Regarding the antecedents of intra-team relations, both aspects of agency and structure were examined. The agency of researchers to set up networks to their liking has been found to some extent constrained within small, dense team networks. In particular, researchers with a strong performance goal orientation refrain themselves from setting mal-adaptive behavior. Furthermore, two contextual factors, which structure the individuals relational behavior, have been found to be relevant antecedents of intra-team relations: team innovation climate and

institutional culture. These two factors affect the presence and structure of single and multiplex intra-team relations. Thus, even though four factors (i.e. achievement goals, trust relations, team innovation climate, and institutional culture) have in this dissertation been identified as antecedents of the individual and team social structure, the results of the empirical studies showed that especially forces of structure shape the team relations and team network structures. Through these findings, major progress is made in the explanation of how individual and team social structures in the specific context of researchers within research teams come into existence. However, the list of antecedents of these structures is expected to be much longer, hence calling for further research on this subject.

The second research question was concerned with the relative benefits of team contacts for individual level innovative performance, when considering that researchers often have a network that stretches further than the team borders. By examining the intra-team interactions, it became clear that team contacts give access to useful instrumental resources and emotional support which stimulates the idea promotion and idea implementation behavior of researchers. However, team contacts were not found to stimulate behavior related to idea ideation. In order to excel in idea ideation, researchers need access to the instrumental resources of other researchers within their organization (i.e. internal bridging contacts), which also contributed to higher levels of idea promotion and idea implementation.

The results concerning the social capital benefits for researchers' innovative work result in two additional points of discussion. First, the benefits that relations bring forward (i.e. social capital) for innovative work behavior are not different for academic researchers than for industrial researchers. In other words, the mechanism of how social interactions bring about social capital returns for innovative work behavior is identical for academic and industrial researchers. However, since academic researchers establish less instrumental relations with team members, it can be argued that there is inequality in social capital benefits for academic researchers in comparison to industrial researchers.

Second, external bridging contacts were not found to contribute to innovative work behavior. This finding questions the general, popularized *'networking'* idea. Employees are made aware of the importance of their network and are stimulated to extend it for their personal success and that of their organization. The extended networks that come into existence through networking have the tendency to exists out of mainly weak relationships (i.e. low interaction frequency, neutral affective relationship, no active trust, etc.). Furthermore, networking as an active behavior implies that individuals have sufficient agency to steer the relations and network structures. It is

only expected to be possible in large and sparsely interconnected networks that individuals have strong agency to shape their networks to their liking (cf. study 1). Researchers that invest much time and resources into networking thus tend to enlarge only the number of external bridging contacts, which are less relevant for individual level innovative performance. The importance of the extended networks obtained through networking can thus be questioned, at least in the case of researchers' innovative work behavior. As seen in the fourth study, innovative work behavior benefits only from relations that are socially and cognitively close. This proximity is only created through strong ties (i.e. frequent interaction, positive affective relationship, active trust, etc), with contacts from within the organization. Thus, rather than stimulating general networking, researchers should be made aware of the potentially relevant resources that can be found within their own research team and organization. From this findings, however, we will not conclude that all contacts with external bridging contacts should be discontinued. The study of Bouty (2000) shows that these contacts are relevant, but that they are only valuable when the investments in the relationship are high. Due to these high investments, it is generally expected that only a few of these relationships can be maintained at one point. The actions required to set up these types of relationships differ from networking behavior, which brings forward a larger number of rather superficial contacts.

The insights of this dissertation bring contributions to several streams of literature. First, even though the small group research has identified relevant group processes for team innovation, these studies neglect to explicitly address the underlying relational structures of these group processes. Hence, this stream of research stays clearly distinct from the social network studies within the small group research that examined the benefits of team relations for team innovation. However, as shown, these streams within small group research are clearly related and by bringing together the studies on group processes for team innovation and social network studies on team innovative performance, the understanding of how team innovation by group processes and social relations is advanced. Second, contributions are made to the psychological innovation literature, which from a social psychology perspective focuses on the social dimension of individual level innovation. This stream of studies demonstrates the need for social relations as motivating and enabling factor for individual innovation. However, these studies focus only on particular types of relationships such as leader-member relationships, and furthermore do not focus on the different types of resources that are exchanged within these relationships. By applying a structural network perspective on social capital and identifying different types of resources, it is possible to critically examine the importance of different types of contacts. Finally, the social network literature is expanded by identifying the need for more studies on antecedents.

The majority of network studies have focused on either the structure or the outcomes of networks. However, once is established that networks have outcomes, also the antecedents become important topics for research.

7.3 Managerial implications

This dissertation started off from the premise that work-related social interactions are crucial for research tasks and thus give benefits to both researchers and research teams. Although this premise is widely spread and accepted, the detailed empirical evidence was not yet provided for the specific case of researchers. With the eye on practical recommendations, as well as on making relevant contributions to the existing research, this study did not only examine which contacts bring forward benefits, but also which factors lie at the basis for the relations with these contacts to be established. The practical recommendations that can be derived from this dissertation are relevant for both individual researchers as well as R&D managers, HR managers, training organizations and professional associations. It is important for these interest groups to gain insight in how the social capital mechanisms works. Work-related network contacts bring forward practical and/or emotional support. This support is not from all contacts relevant and for all purposes useful. Specific for this context, especially team contacts and contacts with other researchers within the organization were found to be relevant. Hence, more attention should go to establishing contact with these groups of contacts, instead of focussing on the general 'networking' practice. When aiming at stimulating the relations within a team, it should be clear for the interest groups that it is as important to focus on contextual factors such as the team climate and the culture regarding teamwork, as on the individual researchers' motivation.

Further, when considering contacts for sharing knowledge, one should be aware of the cognitive distance between the parties, which is a possible pitfall that hampers the exchange. To make sure that parties do not collaborate at cross purposes, communication needs to be adopted to the specific audience and needs to be plain, specific and clear. If not all aspects are clearly specified out loud, misunderstanding can and will happen, jeopardising the benefits of the current exchange and the possibility of future exchanges. Hence, knowledge sharing will demand an investment of time and resources from both parties.

7.4 Limitations

For each of the empirical studies, limitations have been discussed within the chapters. In this section, some more general limitations of this dissertation are considered.

A first limitation is that the research tasks remain a black box. All research tasks are assumed to be innovative, but this includes a diverse set of possible tasks: from radical innovation to incremental improvements of products, procedures or services, from theoretical ideas to applied ideas, from designing consumer products to chemical products. Since social capital returns are goal specific, it can be expected that they not only differ between the three types of behavior researched in this study, but also for the different job contents which in this study all fall under the general label of research tasks.

Second, when examining the antecedents of social relations, it was only assumed that the social relations that were made were with contacts that have valuable and relevant resources. From the data that was collected, it was not possible to derive which resources were searched by the team members and which team members could deliver the resources. With the eye on finding antecedents of social relations that enhance performance, it is important to know the relevance of the abilities of the partners. Since former research has already found that that cooperation partners are chosen on their likeability rather than on their ability (Casciaro & Lobo, 2008), it is an important question to know whether the individual and contextual antecedents stimulate instrumental relations with likeable people or rather with competent people.

A third limitation is with regard to the generalizability of the results. Since the analyses are based on a non-random convenience sample, the generalizability of the results can be questioned. Related to that, it could not be examined, due to the small number of teams present in some disciplines, whether there are difference between the examined disciplines.

Finally, the cross-sectional design of the dataset makes it problematic to determine causality. Our arguments for the antecedents and outcomes of social relations and structures were based on a clear theoretical foundation and follow the direction of causality as established in former research on the topics. Only through a longitudinal design, the direction of the causality can be confirmed.

7.5 Directions for further research

The before mentioned discussion of the results and limitations leads already to further research opportunities. In addition, the research in this dissertation leaves open interesting questions, which also should be addressed by future research. Four specific points of interest are specified here.

First, it remains unclear whether individuals are able to structure their own network. Individual aspects which are expected to steer the behavior of individuals, such as achievement goals, values,

personality, do not bring about the network structures that would be expected. For example in paper one, the ability of individuals to form team network structures according to their achievement goals was examined. Even though experimental studies had linked an performance goal orientation with mal-adaptive behavior, no signs were found of this type of behavior when investigating the team networks related to goal orientation. As mentioned in the discussion of this paper, similar results were found in other research concerning the role of personal characteristics on network structure and furthermore pointed out that the results they did find showed rather modest impact on the explained variance. This leads us to the conclusion that perhaps only in more sparse and large networks, individuals will have agency in structuring their networks. Hence, further research should examine the effect of enduring personal characteristics in different social structures and examine to what extent and in which situations the network structures can actively be influenced by the behavior of individuals.

Second, the study of team climate and network structures should not be limited to team level outcomes, but should rather be extended to include also individual level outcomes. Up-until now, most research on team climate and network structures has only been related to team level outcomes. When considering individual level outcomes, team network structures are reduced to the networks that individuals hold within a team and team climate limited to the psychological climate of individuals (Henttonen, 2010; Hulsheger, Anderson, & Salgado, 2009). This conceptualization does not take into account that team networks and team climate can have an additional influence on the individual behavior, apart from the individual level influence of psychological climate and the individual network structure. Hence, in line with Hirst, van Knippenberg and Zhou (2009) and Chen and Kanfer (2006) team climate and network structures are proposed to be defined as cross-level concepts influencing individual behavior.

Third, the formal and informal leaders within the network should be studied, thereby integrating the large leadership literature with (team) social network studies. Especially instrumental networks of academic teams were found to be centralized, segmented and low in transitivity. This points to the presence of one or more focal actors around which the team network is formed. It would be relevant to examine whether these focal actors are formal or informal leaders. Interesting research questions to address are: Are team leaders the brokers within a team?, Are there leadership styles connected to the network positions?, and Do they occupy the same structural position in academic and industrial teams?.

Finally, more research attention should go to one particular group of research team members: the laboratory technicians. Technicians have a facilitating role within the team, by giving practical

support to the researchers or executing parts of the research for the researcher. Even though, when even present at all, only a few technicians are present in each team, they have specific characteristics take make them interesting to research. For example, technicians usually have a bachelor degree, while researchers have mostly master or doctorate diplomas, and are concerned with empirical testing of predefined experiments (Barley, 1996). However, their role should not be seen as servants, only executing predefined tasks. Rather, they are experts on which the team members rely for their research and which have a high level of technical knowledge and have to do a great deal of problem solving (Barley, 1996). Hence it would be interesting to examine the place that technicians take up in the team network. Do researchers see the interactions with lab technicians as cooperation relation? In how far do technicians perceive themselves as part of the team? Are technicians central in the team?

7.6 Concluding remark

Throughout the years, researchers have become more and more embedded within social structures. This development is not because researchers are extremely gregarious beings. Rather, it is the nature of their tasks, and the way these tasks are organized that encourages researchers to set up collaborations with other researchers. Managers stimulated the collaboration within team structures with the eye on improving the team and organizational performance. Relationships within teams are mainly shaped by contextual factors such as team innovation climate and institutional culture, rather than by the agency of the individual researchers. However, the embeddedness within the team and organizational network brings also social capital benefits for the individual researchers. Researchers that are well embedded within these networks have an enhanced innovative performance. Thus, even though researchers were stimulated through managers and policymakers to set up collaborations for enhancing the organizational effectiveness and economic gains, individual researchers themselves also gain from these collaborations for their own innovativeness.

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